VOLUME XXXVI NO. 192 MAY-JUNE 1952

LAND SEA AIR ORDNANCE

LIEUTENANT GENERAL EARLE E. PARTRIDGE
Chief of the Air Research and Development Command

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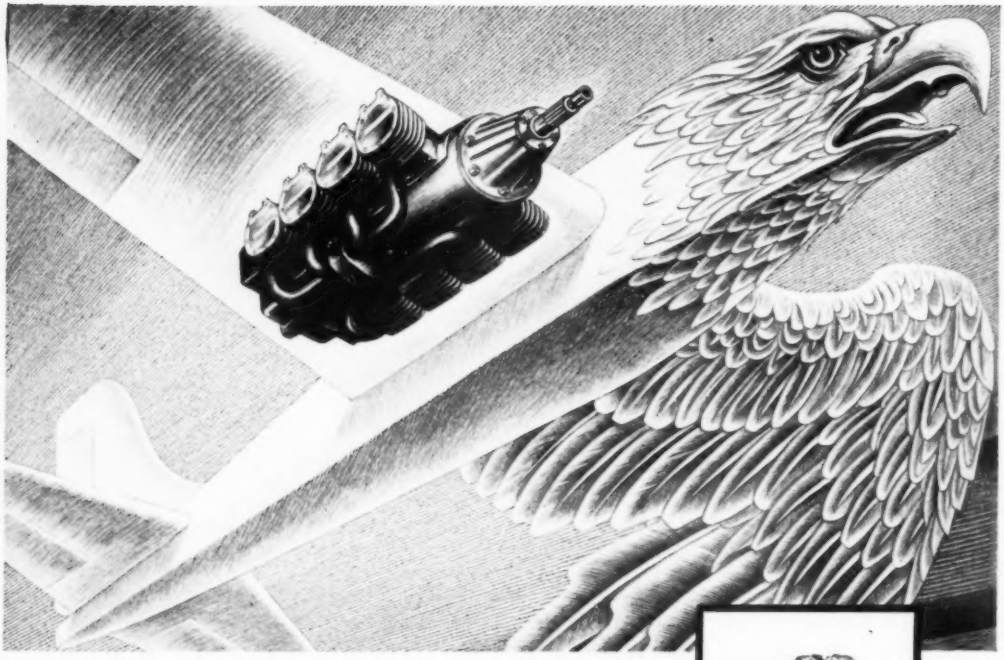

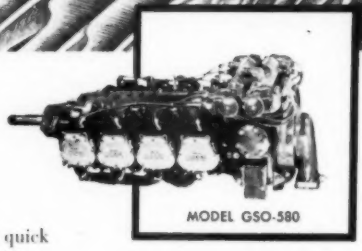

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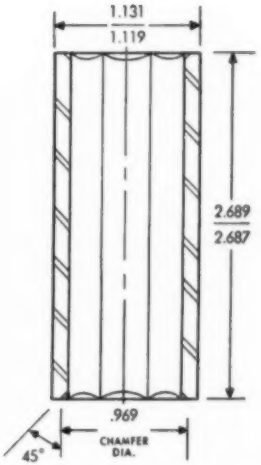

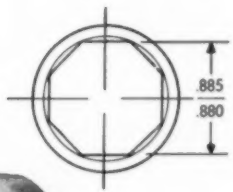

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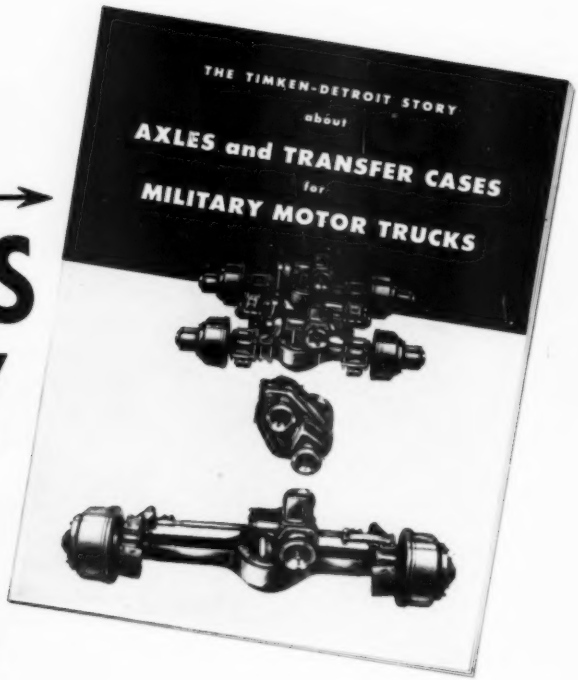

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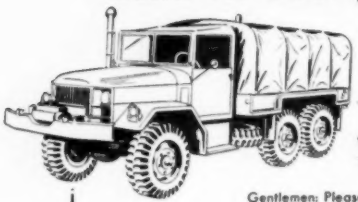

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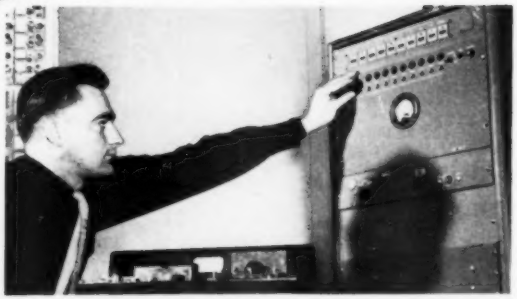

Thunder hunting equipment on location near Madison, Florida. Loop antenna on truck picks up static. The engineer in top picture is watching the indication of a circuit which registers how often the static exceeds a given level.

Many new telephone circuits have two jobs to do—carrying your voice and transmitting signals to operate dial exchanges in distant towns. And an old-fashioned thunderstorm can interfere with both!

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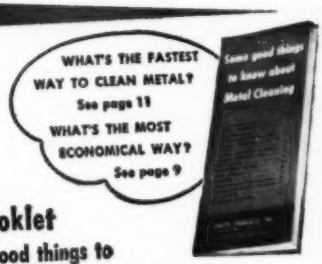
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See page 11
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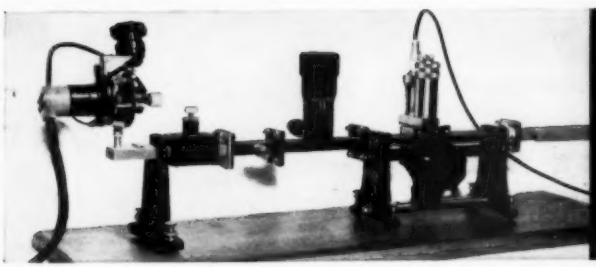

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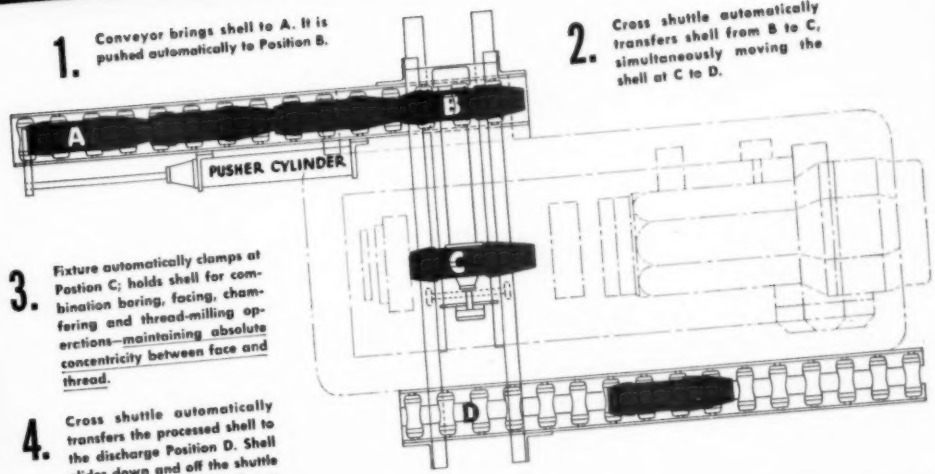
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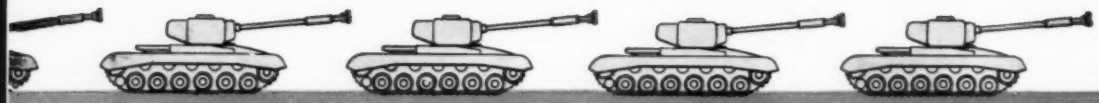

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Increasing demand for armor plate plus our known record of achievement in the past resulted in the request by the Government that we bring together a group of companies sufficiently large and having the necessary facilities to make armor plate for tanks and armored vehicles.

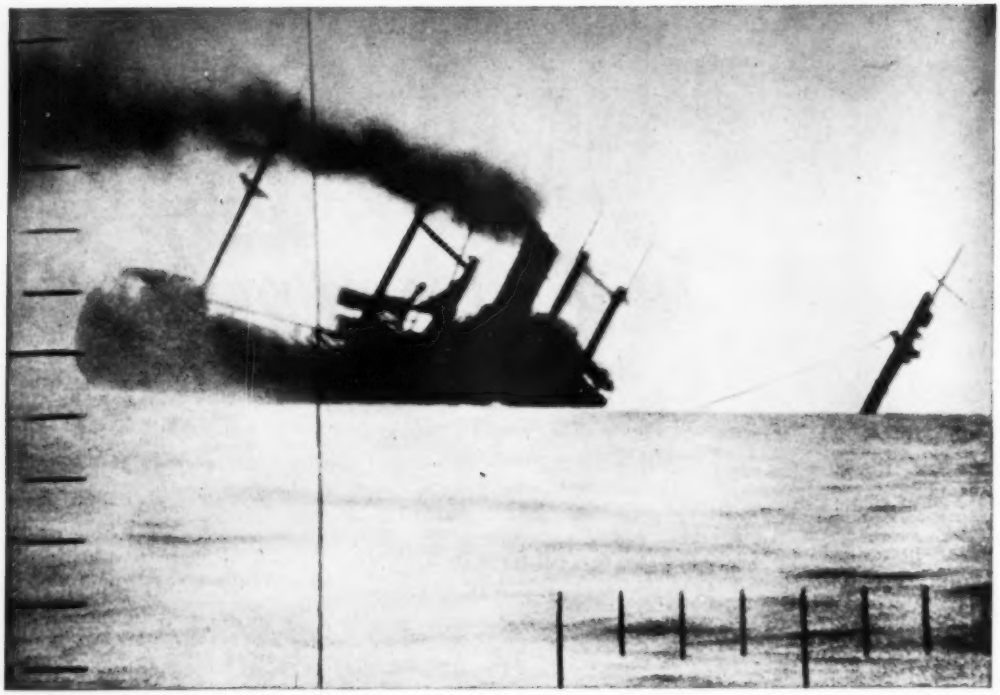
Starting from scratch in November 1950, a multitude of plants who might qualify were screened; their organizations, equipment, labor supply and locations analyzed. This great arsenal of twenty fully equipped and staffed armor plate production units has been the result.

From our armor plate headquarters, centrally located in Detroit, we guide the activities of our associates, work in close contact with procurement, engineering, production and inspection.

Now an ever increasing flow of flat or formed, fully machined parts is reaching prime contractors. This is our way—the American way to build the armored might that will withstand any challenge in the future.

Standard Steel Spring Company

ARMOR PLATE DIVISION • PENOBSCOT BLDG. • DETROIT, MICHIGAN



What it takes to score a hit!

Steel, 2,423 lbs. | Explosives, 600 lbs. | Gauges, 300 | Parts, 4,000 | Skilled Man-hours, 3,000

A torpedo must have the accuracy of a stopwatch... the blast of a blockbuster to score a hit like the one shown above. Like all modern weapons, its effectiveness depends upon the technical *skill* and *speed* of its makers.

American Machine & Foundry is pleased to make its contribution to the Torpedo Branch, Navy Bureau of Ordnance. Along with hundreds of other companies, we are doing our best to produce our share of "hits".

Above figures are given with due regard to security.

AMERICAN MACHINE & FOUNDRY COMPANY

Executive Offices, 511 Fifth Avenue, New York 17, N. Y.

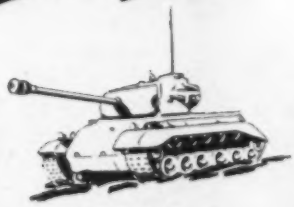
AMF does it better—automatically!

CREATORS AND PRODUCERS OF ELECTRONIC AND MECHANICAL EQUIPMENT

FOR THE ARMED SERVICES: Radar antennae and drive units • automatic loaders for Army and Navy weapons • elevating and azimuth mechanisms • cooling fans for Army tanks • airplane parts • mobile ovens • electronic training devices • naval ordnance • rolled and welded steel products • shell components • silver-zinc batteries • special military projects.

FOR INDUSTRY: Tobacco processing equipment, cigarette and cigar machinery • AMF and Union bakery equipment • automatic pinspotters, bowling equipment and supplies • DeWalt power saws • Lowerator dispensers • Oakes continuous mixers • stitching machines • Wahlstrom chucks • Roadmaster bicycles • Cleve-Weld tire rims • Junior velocipedes.

Equipped to Deliver for National Defense



Delco Radio

Regardless of what type of radio equipment is needed . . . when it's needed . . . where it's needed . . . Delco Radio delivers the goods! Delco Radio has fine manufacturing facilities . . . long and varied production experience. Delco Radio is—*right now*—building an impressive variety of advance-type radio equipment for America's fighting forces. You can depend on Delco Radio for *uniform* product quality and *on-time* delivery.

DELCO RADIO
Division of General Motors
Kokomo, Indiana

FIRST

IN PRODUCTION

Delco Radio is the world's largest builder of vehicular radios—the leader in production and assembly of component parts.

FIRST

IN ENGINEERING

Delco Radio developed many of the most important advances in vehicular radio . . . has outstanding experience in this field.

FIRST

IN QUALITY

Each and every step in the manufacturing of Delco Radio products is closely supervised to maintain high, uniform product quality.

FIRST

IN MANUFACTURING

Completely integrated for efficient production from raw material to finished product, Delco Radio meets any customer need.

NEW FREE BOOK

shows how

creosoted timber piles save money... assure permanent foundations

● Here's a book every engineer should have. It's filled with interesting facts. Graphic descriptions. Photographs of modern construction projects, large and small, that are founded on pressure-creosoted piles.

An interesting book, yes—but informative, too. Case histories tell how substantial savings have been effected and unusual construction problems have been solved by founding permanent structures on creosoted timber piles.

You'll find this book a valuable reference. Send for a copy today. There's no obligation involved.

KOPPERS **PRESSURE-TREATED WOOD**

KOPPERS COMPANY, INC. · Pittsburgh 19, Pa.

CHRYSLER AIR RAID SIRENS

Selected to Warn Arsenal of Democracy

DETROIT IS PREPARING WITH 20 CHRYSLER SIRENS

As guardians of America's primary target, Detroit Civil Defense Officials are acutely conscious of their city's importance to Civil Defense. They are protecting their homes, children and factories with a modern, up-to-date Air Raid Warning System. They are installing Chrysler Air Raid Sirens. Here's why:

The *new* Chrysler Air Raid Siren produces the loudest warning sound ever achieved for modern production. It is powered by a new 180 horsepower V-8 Industrial engine, making it *independent of vulnerable central power systems.* One or any number sirens may be *remotely controlled* from a central control station if desired. It is clearly recognized over a diameter of 8 miles . . . *and it is the least expensive, 138 decibels (100 ft. from throat) of warning sound on the market today!*

For complete information, specifications and availability for your city, town or industrial plant write: ***Marine and Industrial Engine Division, Chrysler Corporation, 12206 E. Jefferson Ave., Detroit 31, Michigan.***

CITY TO GET RAID SIRENS

First Warning Units to Be Installed in March

Detroit's civil defense program took a step forward Saturday as arrangements were made for delivery and installations of a siren-warning system and the first emergency medical supplies began arriving for distribution to casualty care stations.

Brig. Gen. Clyde E. Dougherty, director of the Detroit Office of Civil Defense (OCD) said the first two of 20 sirens would be installed early in March.

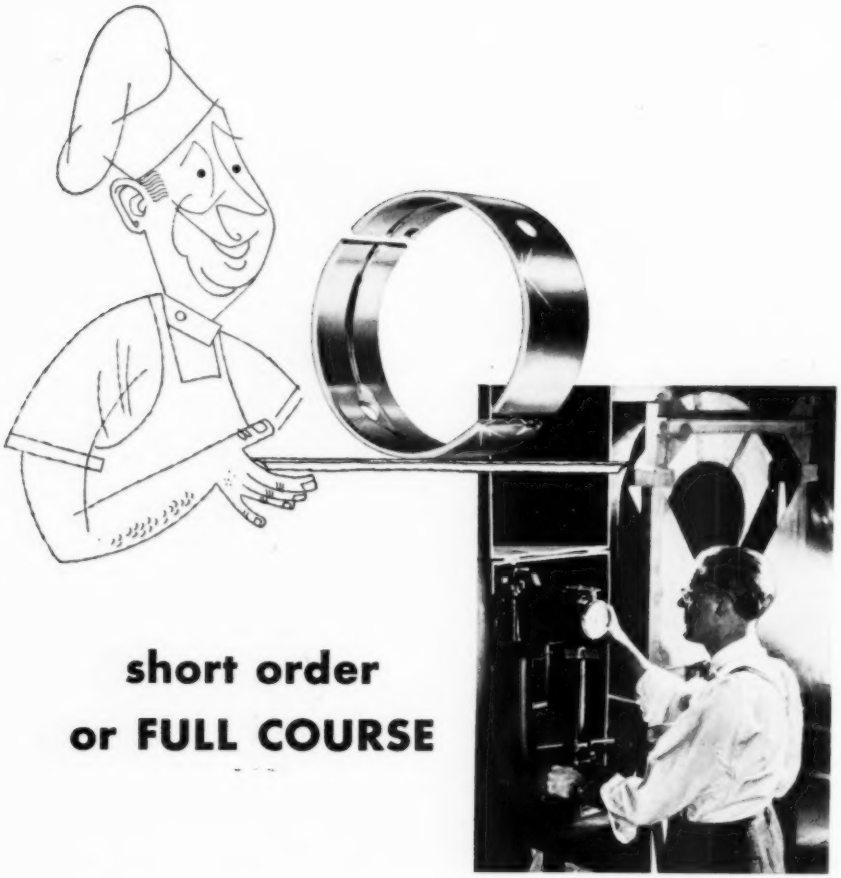
The first installations will be on top the Sheraton-Cadillac Hotel, for the downtown area, and the General Motors Building, for the New Center area.

The siren committee of the Detroit OCD decided to use a new type 180 horsepower unit manufactured by the Chrysler Corp. The choice was made after more than a year of study and comparisons of various warning systems.

Dougherty said about $100,000 was saved by waiting for the development of the new and better siren.

He estimated that the complete warning system would cost about $200,000, half of which is Federal funds and half City. All but two of the powerful sirens will be placed on roofs of fire stations.

All sirens will be activated from remote controls.



short order
or FULL COURSE

We can meet your most exacting requirements for custom quality engine bearings in small runs or mass-production quantities.

Our exacting production techniques have been developed over the years to cope with today's fluctuating demands for automotive, tractor and industrial engines.

When you specify our engine bearings you gain the "know-how" of more than 25 years of precision experience in the manufacture of the finest engine bearings.

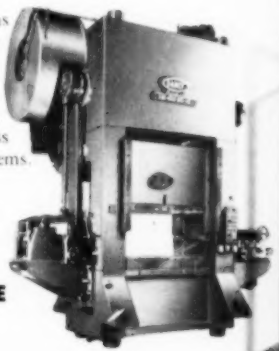
DETROIT ALUMINUM & BRASS CORPORATION

DETROIT 11, MICHIGAN

Is there a press that requires less floor space?

Rising costs of new construction and increasing production demands put every square foot of factory floor area at a premium.

Danly Presses, all designed for space efficiency, help you get the most out of the floor area you have. The Danly Autofeed Press shown here is particularly good for space efficiency . . . extra rigid construction and long, precision gibbing permit combination of separate stamping operations into one die in one press! Higher operating speeds at higher tonnages make it easier to meet schedules too. Multiple press set-ups are often replaced!



Write today for information on Danly Autofeed Presses . . . and remember, Danly engineers are at your service to discuss your specific press selection, installation or operation problems.

DANLY MACHINE SPECIALTIES, INC.
2100 South Laramie Avenue, Chicago 50, Illinois

DANLY HELPS MANAGEMENT SOLVE TODAY'S CAPACITY PROBLEMS!

Mechanical Presses . . . 50 to 3000 Tons

DANLY

IT COSTS LESS TO RUN A DANLY PRESS!

What is vital to every job being done in America today?

The answer is *transportation* — the mammoth task of distributing products, materials and services . . . and of getting people to and from their work.

It is vital because it affects *every* business and touches every job in this country today.

And highways play a very important part, along with railways, airways and waterways. Three-quarters of all the freight moved in America travels by truck, and 90% of all intercity passenger travel is by car and bus. Many thousands of communities depend almost entirely on roads and motor vehicles for transportation and supplies.

The contribution of motor vehicles to the American economy would have been impossible without the "know-how" of the builders of highways that has brought such improvement in the construction of streets and highways.

Since we of Chrysler built our first car in 1924, we have seen highway improvements unthought of then. Improvements not only in the number of highway miles, but in surfacing, in durability, in all-weather use . . . in the safety of grades and curves, lighting and intersections . . . in the great new turnpikes and expressways.

These advances have been vital to the nation and are a primary source of our strength today.

But much remains to be done to provide for the continuing and expanding usefulness of automotive transportation.

The need for maintaining our present roads and for building new highways is pressing in many parts of this country. So is the need for better parking facilities in cities and towns . . . for street planning and building that can keep traffic moving ever more efficiently.

The builders of America's roads have already created the best highway system in the world. These roads, and the cars and trucks that roll on them, have provided the nation with one of its greatest production tools. Distance no longer limits the things we can make or do. Any business can distribute its products anywhere and men and women can get to their work by motor vehicle no matter where they live.

The usefulness of motor vehicles will increase still more as our highway system expands and improves. Each new mile of road will contribute to our country's strength.

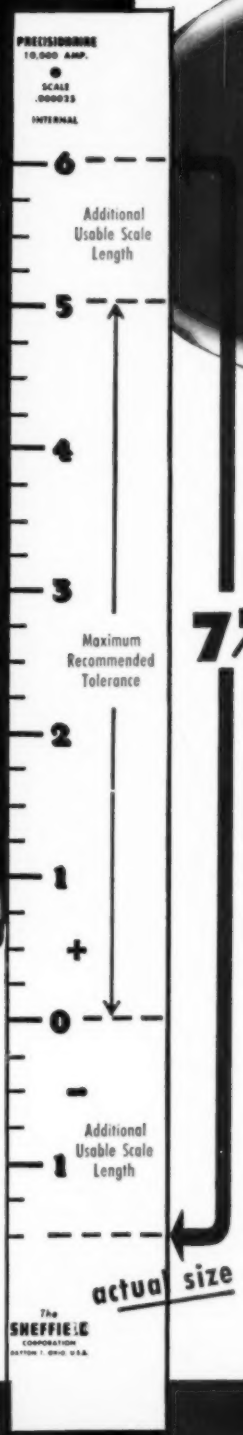
Chrysler Corporation

PLYMOUTH • DODGE • DE SOTO • CHRYSLER

DODGE "JOB-RATED" TRUCKS

Twice as much Usable Scale Length
with a

SHEFFIELD COLUMN PRECISIONAIRE



MODEL NUMBER	MAXIMUM RECOMMENDED TOLERANCE	MINIMUM USABLE SCALE LENGTH BEYOND TOLERANCE LIMITS
1,000	.005	.0025
2,000	.0025	.0013
5,000	.001	.0005
10,000	.0005	.00025
20,000	.00025	.000125

7½ inches of usable scale length—more than twice as much as most other air gages.

MANY MORE CLASSIFICATIONS—more selections can be made because of the extra scale length—manufacturing tolerances can be widened to save time and cost without sacrificing quality.

SHOWS *HOW MUCH* PARTS ARE OUT—especially advantageous where parts are coming consistently on the borderline or just outside tolerance limits.

BETTER FOR BRINGING TO SIZE—Readings can be taken earlier when approaching size so that the operator is sure of not going beyond tolerance, in fact, he can accurately work to desired limits *within* the tolerance zone.

CLOSER MACHINE CONTROL—with greater scale length the trend of the machine and tooling to go out of control *shows up sooner*, reducing possibility of rejects.

MORE ACCURATE QUALITY CONTROL CHARTS—the column Precisionaire scale is a running quality control chart in itself. Readings can be transferred to a chart with greatest accuracy.

OPERATORS LIKE THE LONG SCALE—with higher amplifications the spread for the tolerance and each classification is wider, making the operator's job easier.

PHONE, WIRE, OR WRITE CUSTOMER CONSULTATION FOR DEMONSTRATION IN YOUR PLANT. CATALOGS CAN BE SENT AT ONCE.

the *Sheffield* corporation
DAYTON 1, OHIO, U.S.A.

GAGES • MEASURING INSTRUMENTS • MACHINE TOOLS • CONTRACT SERVICES • THREADING TOOLS

NEW ARMY "OTTER" Newest, most versatile of Army amphibious vehicles, scheduled for production by the Pontiac Division of General Motors, the "Otter," boasts the Army, can turn on a dime, swim, plow through mud and travel on dry land at speeds up to 36 miles an hour. Its efficient heating system relies on the South Wind "978"... for heating personnel and preheating the power plant.

NEW REO "EAGER BEAVER" Army's newest six-by-six . . . 2½ ton heavy-duty utility vehicle and cargo carrier. Can travel up 60% grades or under water. A South Wind "978" defrosts windshield, keeps cab and personnel warm.

GENERAL PERSHING The Army's World War II medium tank – the M26. Personnel of this mighty, armored Goliath are kept comfortably warm, thanks to a South Wind "978" heater.

"MOBILITY RETAINED IN WINTER" WITH NEW MILITARY HEATER

South Wind "978" Preheats, Heats and Defrosts Army Vehicles Even at 70° Below

Keeping vital equipment functioning . . . skilled personnel warm under the severest weather conditions. It's one of many problems faced by the nation's new, more mobile, harder striking armed forces. A problem now successfully solved by an amazing new military heater—the South Wind "978."

Simplified in design. Compact. This rugged forced air heater preheats, heats, and defrosts in any type of military vehicle—in temperatures as low as 70° below zero. Dependably safe because the combustion air system is completely separated from the ventilating air stream. Always fast acting because warm air circulation doesn't depend on engine heat.

Built to Army Ordnance Specifications, the "978" has been standardized by the Army for its winterization program. And, because of its many exclusive advantages, promises to be influential in fashioning future designs for commercial car heating, too.

IMPORTANT: For complete details *plus* experienced engineering assistance, wire, write or phone Stewart-Warner Corporation, South Wind Division, Dept. L-52, 1514 Drover Street, Indianapolis 7, Indiana.

STEWART-WARNER

South Wind

REG. U. S. PAT. OFF.

PERSONNEL HEATING
ENGINE AND EQUIPMENT PRE-HEATING
WINDSHIELD DEFROSTING

Connector Problem?

...We'll take it from HERE

Good ideas for electronic circuitry sometimes run afoul of connector problems. Maybe existing connector units won't hold air pressure gradients, won't stand the heat, aren't rugged enough for the job. Or maybe it's a question of altitude, or under-water application. But if you can sketch the circuit, we'll take it from there. We've engineered so many special connectors, solved so many "impossible" problems, that whatever the requirements are, we can usually provide the answer.

Lightweight actuators for any requirement.

Job engineered, welded-diaphragm bellows.

Flexible conduit and ignition assemblies.

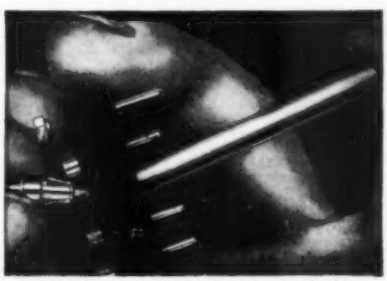
Aero-Seal vibration-proof hose clamps.

WRITE TODAY for specific information, or send us your sketches. We'll forward recommendations promptly.

BREEZE
Special CONNECTORS

BREEZE CORPORATIONS, INC.

41 South Sixth Street — Newark, New Jersey


Removable pins in Breeze connectors speed soldering, save time, trouble. Pins snap back into block.

CONSTANT VELOCITY
UNIVERSAL JOINTS

RZEPPA BELL TYPE

High angularity up to 35°. Seven standard sizes, from 15/16" to 2½" shaft sizes. Torque transmitted by 6 accurately aligned steel balls. No external thrust bearings needed. Radial and axial loads carried by spherical surfaces.

TRANSMIT CONSTANT, VIBRATIONLESS, UNIFORM POWER

These joints offer ordnance and industrial design engineers true constant velocity—free from the alternate pulsations that set up vibration even at slight angularity and destructive force as angularity increases.

The field records of over two million Rzeppa joints in the several divisions of our armed forces prove their dependability. The Rzeppa joint consists of an outer driving member and an inner driving member, with a ball cage between them—all assembled into a concentric unit. Each of the six balls transmits torque by free rolling action. No tools are required to assemble the various parts which position each other securely by interlocking. The result is a joint combining great strength, high capacity, constant velocity, compactness, low friction losses and the utmost in dependability.

You are invited to discuss any problems concerning universal joints with our engineering staff, whose long experience in many fields is available to manufacturers of ordnance and industrial products.

RZEPPA DISC TYPE

For low angle operation. Capable of 18° deflection. Sizes from 1⅞" O.D., taking ⅜" shaft and weighing 5 oz. to 10½" O.D., taking 3" shaft and weighing 62 lbs.

MANUFACTURED BY

The **GEAR GRINDING MACHINE CO.**

DETROIT 11, MICHIGAN

RZEPPA *Constant Velocity Universal Joints*

Guarding Signal Corps Equipment from Fastener Failure

Communications equipment for mobile tactical units must be sturdy enough to follow the front lines cross-country and along battle-pitted roads. This AN/GRC-3 radio equipment, installed in all types of combat vehicles, must be ready to provide communications liaison between advancing units. And it must be ready twenty-four hours a day, despite the roughest operating conditions. For vital equipment of this type there is a growing recognition of the need for self-locking fasteners to protect the expensive and critical component parts which make them function.

Helping to keep this equipment operating by holding against severe and long-continued vibration are many ESNA machine screw hex nuts and clinch nuts. These Elastic Stop Nuts—*with fungus proof nylon inserts for extended reuseability*—offer the advantages of secure fastenings and at the same time simplify maintenance and field repairs.

ESNA HEX NUTS are quickly installed with power tools—permit accurate, precise adjustments, lock at any position along the bolt, and keep fastenings tight until deliberately removed.

ESNA CLINCH TYPE NUTS are available in various shank lengths for swaging on different gauges of sheet metal. Permanently clinched into place on frame members or to sections of the chassis, they provide permanent and pre-positioned fasteners for assembling panels or mounting component parts.

Red Nylon locking inserts
Reusable over 100 times

DESIGN AHEAD WITH ESNA

THE FAMOUS RED ELASTIC COLLAR IS VISIBLE EVIDENCE OF LOCKING SECURITY

Threadless and permanently elastic, it provides these 4 outstanding features:

1. Protects against nuts loosening due to VIBRATION
2. Keeps locking threads CORROSION FREE
3. Provides for accurate BOLT LOADING
4. Seals against LIQUID LEAKAGE along the bolt threads

And can be used again and again

ESnail® ESNA TRADE MARK ROLLPIN TRADEMARK

ELASTIC STOP NUTS

DESIGN HEADQUARTERS FOR VIBRATION-PROOF FASTENERS

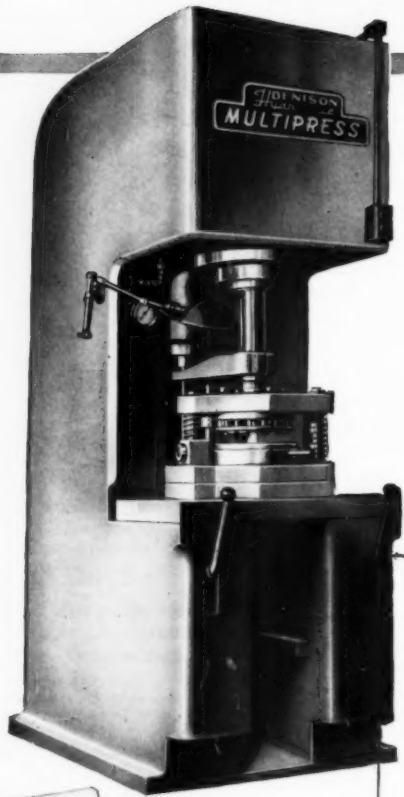
Specify ESNA hex and clinch nuts with the new red nylon insert *to assure adequate locking torque through hundreds of on-off applications.*

When you design equipment that needs similar fastening security, specify Elastic Stop Nuts. For complete dimensional and installation data write to Elastic Stop Nut Corporation of America, Vauxhall Road, Union, N. J.

FOR FASTER PRODUCTION PLUS

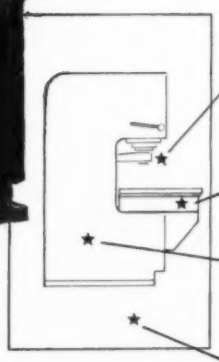
QUICK CONVERSION

standardize on MULTIPRESS®



Wide-range adjustability of action makes Multipress the quick, high-production answer to an amazing variety of manufacturing needs – ordnance jobs included. This easy adaptability pays a bonus *every time* you switch from one type of operation to another—now or later. You can convert *rapidly*, for fast production and better results, when you standardize on Multipress equipment. And *early deliveries* on most Multipress equipment give you another break on your production planning.

Here are some available Multipress features that bring you these profitable advantages:



1. FULLY ADJUSTABLE:
Stroke Length
Tonnage
Ram Traverse Speed
Pressing Speed
Ram Dwell or Time Delay
Ram Cycling (automatic)
Single or Sequence
Vibratory Ram Action

2. EASILY EQUIPPED WITH:
Multipress Index Table Feed
Multipress Dial Feed Tables
Multipress Harmonic Stock Feed
Hopper Feeds
Standard Tooling Fixtures

3. WIDE RANGE OF SIZES
8 Frame Sizes
11 Tonnage Capacities
Interchangeable Power Units, Cylinder Assemblies and Control Valves

4. PLUS:
Good Deliveries

1 to 50-ton capacities

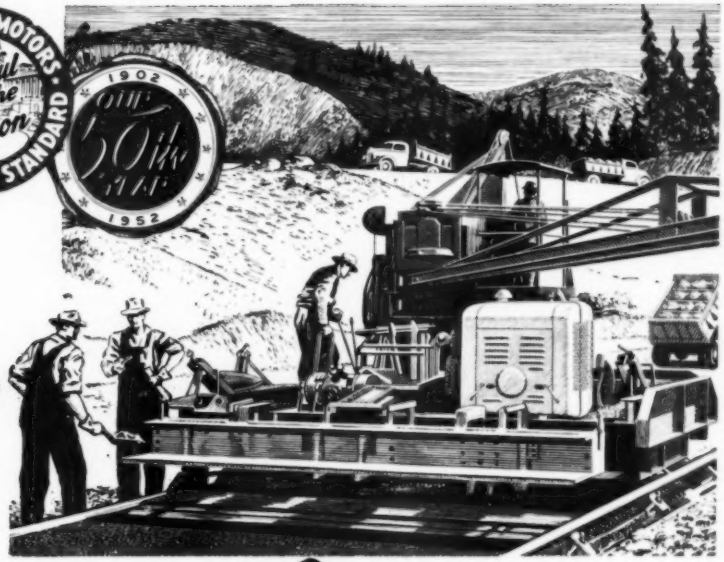
WRITE TODAY: for full details on the versatile Multipress and its wide range of accessory equipment.

DENISON HydrOILics

The DENISON Engineering Company, 1205 Dublin Road, Columbus 16, Ohio

CONTINENTAL MOTORS · Powerful as the Nation · AMERICA'S STANDARD

1902 Over 50 Years 1952

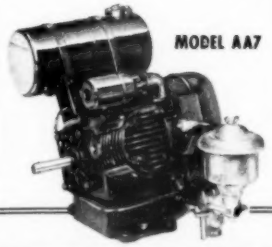


Speed the Job ... and Cut the Cost ... with

Dependable RED SEAL POWER

SMALL AIR-COOLED ENGINES

In addition to 4- and 6-cylinder liquid-cooled engines from 13 to 188 h.p., Continental builds 10 four-cycle air-cooled models for a wide range of industrial uses requiring from 1½ to 2½ h.p. They are backed by service and parts in every community. For information on this line, please address Air-Cooled Engine Division, 12800 Kercheval Avenue, Detroit 14, Michigan.



MODEL AA7

Road building is only one of many types of defense construction where work is speeded and money saved by use of Continental-powered equipment.

You find Red Seals of varying sizes and specifications in more and more leading makes of shovels, cranes, conveyors, draglines, winches and pumps at the pit; in trucks hauling materials to the job; in mixers, trenchers, earth-movers, spreaders, rollers, and other machines at the job site. They deliver their full work quota at lower cost, with less down time, because each is engineered expressly for its job—built to do one thing and do it well.

PARTS AND SERVICE EVERYWHERE

Continental Motors Corporation
MUSKEGON, MICHIGAN

New Departure operates guns-and-butter plants

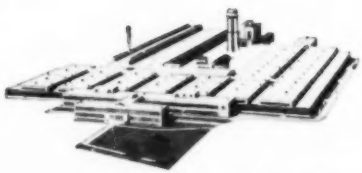
U. S. Army Photo

Ball bearings are essential to the products of our industrial might.

The ball bearings that serve millions of automobiles, trucks, tractors, farm implements, electric motors and industrial machinery are of the same materials, the same heat treatment, the same methods of precision manufacture as those required for mechanized warfare and electronic instruments. Thus conversion from one to the other at New Departure is largely a matter of changing the emphasis on types and sizes.

The productive capacities of the world's largest ball bearing factories are your assurance of the best possible production of your requirements.

New Departure's engineers and vast resources for research are freely at your disposal.



New Departure's plant at Sandusky, Ohio, where ball bearings are produced for *both* industry and the Armed Forces.

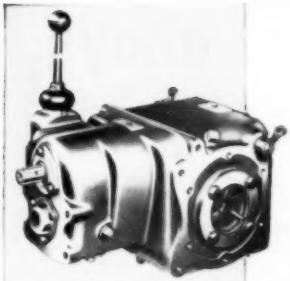
NEW DEPARTURE

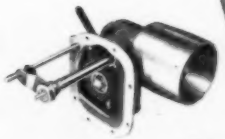
Nothing Rolls Like a Ball... **BALL BEARINGS**

164

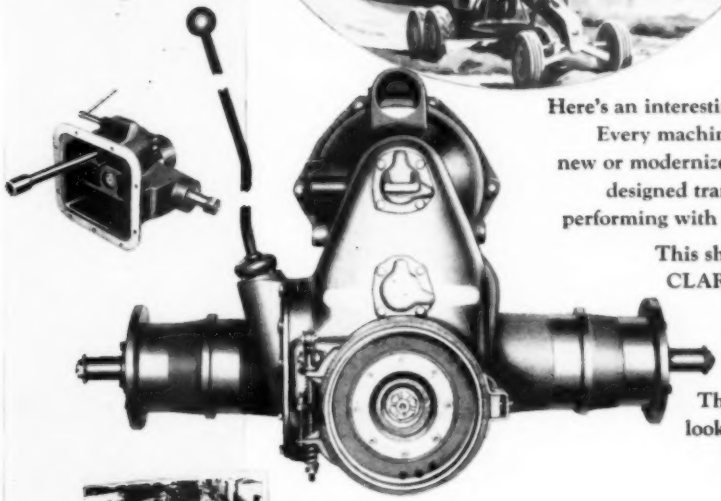
NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

Looking For Machines To Help Do A Better Job....





CLARK DRIVE UNIT



This pocket size book briefly describes and illustrates Clark Products. You are invited to send for it.

Here's an interesting and commendable record: Every machine—agricultural or industrial, new or modernized—equipped with a CLARK designed transmission-axle driving unit is performing with efficiency and dependability.

This shouldn't surprise anyone—for CLARK brings to the assignment a seasoned and resourceful engineering experience that goes back 35 years.

The Clark Drive-Unit is on the lookout for heavy duty machines that might well benefit from a closer acquaintance.

PRODUCTS OF CLARK — TRANSMISSIONS • AXLES • AXLE HOUSINGS • TRACTOR DRIVE UNITS • FORK TRUCKS AND TRACTORS • POWERED HAND TRUCKS • GEARS AND FORGINGS • ELECTRIC STEEL CASTINGS

CLARK EQUIPMENT COMPANY • BUCHANAN, MICHIGAN

Other Plants: BATTLE CREEK *and* JACKSON, MICHIGAN

Reduce the use of critical alloys in gas turbine structures

N-A-X AC9115 ALLOY STEEL offers a means of reducing the use of critical alloy steels of the "stainless" type in gas turbine and similar applications. In specific cases it has replaced over half the amount of strategic material originally required, with no sacrifice of quality.

N-A-X AC9115 ALLOY STEEL has high strength and toughness values at temperatures ranging from −70° F. to +1,000° F. It can be readily cold formed into the most difficult shapes; its response to welding by any process is excellent. It must, however, be suitably coated for protection against cold or hot corrosion.

N-A-X AC9115 ALLOY STEEL is available in bars as well as flat rolled products. Investigate the outstanding properties and characteristics of this steel and, through its use, conserve the critical material so necessary to our nation.

with N-A-X AC9115

ALLOY STEEL

GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division • Ecorse, Detroit 29, Michigan

NATIONAL STEEL CORPORATION

Always give more than you promise

JOHN M. STUDEBAKER

There were five Studebaker brothers: Henry, Clem, John, Peter and Jacob. They were a combination of American stock that included the talents of blacksmith, financier, farmer, merchant and pioneer.

From the lengthened shadow of their blacksmith and wagon-building shop, started in South Bend, Indiana, on February 16, 1852, has grown Studebaker . . . the world's largest independent manufacturer of motor cars.

Although the product, personalities, factories and customers have changed through the years since 1852, there is visible continuity of the policy that has been the mainspring of Studebaker's century of progress:
"Always give a little more than you promise."

THE NEW 1952

Studebaker

. . . a tribute to 100 years of giving more than promised

Jacob Studebaker

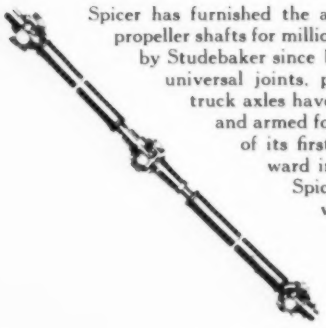
John M. Studebaker

Clem Studebaker

Henry Studebaker

Peter Studebaker

Since 1905, Spicer Equipment has helped Studebaker build its world-wide reputation for Quality Motor Vehicles



Spicer has furnished the axles, universal joints and propeller shafts for millions of the passenger cars made by Studebaker since 1905. And for many years Spicer universal joints, propeller shafts and light delivery truck axles have been used in Studebaker commercial and armed forces vehicles. From the broad foundation of its first century of success, Studebaker looks forward into another century of growth and expansion. Spicer joins the entire automotive industry in best wishes for continued progress.

SPICER MANUFACTURING

Division of Dana Corporation • **TOLEDO 1, OHIO**

48 YEARS OF Spicer SERVICE

TRANSMISSIONS • UNIVERSAL JOINTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • PASSENGER CAR AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES

NOW you can ROLL light and power *RIGHT TO THE JOB* with National Electric's

NEW ROLLA-DUCT

Circuit breaker for full worker protection. Entire unit fully grounded.
Power and Light Unit provides 8 grounded electrical outlets, two flood-light sockets, circuit breaker and toggle switch for lamps.
Lighting heads with four flood lamp sockets (or infra-red heat upon request), one duplex outlet and circuit breaker toggle switch control also available.
Sturdy, all-steel tubular carriage. May be elevated to 5½ ft. or can be rolled under jobs.
Power head on ball-and-socket swivel locks into any horizontal or vertical position.
Heavy duty, Neoprene jacketed Indestructo cable—21 ft., three-conductor, 12 A.W.G. power cable.
Rugged, non-conductive wheels resist chemicals, moisture, oil.

ROLLA-DUCT ELEVATED

Portable branch circuit extensions designed to transport power, light or heat to maintenance and construction jobs.

Rolla-Duct mounted units carry an approved rating for 20 ampere loads, 115 volt operations.

No need to relocate light and power outlets to meet extra demands of assembly lines, temporary lighting or general maintenance. Rolla-Duct supplies light and power wherever the standard wiring system is inconvenient to use.

Listed by Underwriters' Laboratories, Inc.

Sold Thru Leading Electrical Wholesalers.

IDEAL FOR ARMED FORCES BASES GENERAL MAINTENANCE

Write for complete information on Rolla-Duct. Use the handy coupon.

National Electric
PRODUCTS CORPORATION
PITTSBURGH, PA.

National Electric Products Corporation
1383 Chamber of Commerce Building
Pittsburgh 19, Pennsylvania

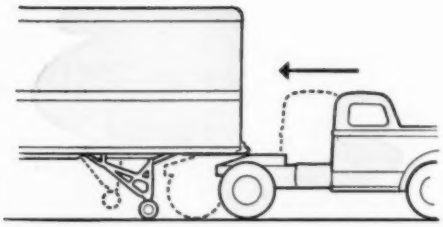
Please send me complete information on Rolla-Duct. I am interested in using it for:

Name _____ Title _____

Company _____

Address _____

POWDER HAULING MADE *SAFER* BY FRUEHAUF ENGINEERING



FRUEHAUF
***Full Automatic* Supports**
add Safety—Save Time, Effort, Cost.

DURING World War II, Fruehauf and Army Ordnance engineers successfully developed the Full-Automatic, Cab-Controlled Van-Semi-Trailer for maximum safety and efficiency in moving explosive powder. Nearly 3,000 of these exclusive Fruehauf units were built. They received universal acceptance by both government and privately operated plants throughout the country.

An improved Fruehauf Powder Haul Van is now available. An outstanding example of Fruehauf engineering and manufacturing experience, it incorporates every possible special safety feature to eliminate human contact with the Trailer and minimize powder hauling hazards.

Hazards Minimized by these Special Safety Factors

1. All *interior body surfaces are of non-sparking non-ferrous metals.*
2. Interior walls and doors are lined with laminated wood fastened with brass screws.
3. The sturdy oak floor is fastened by brass bolts to a steel sub floor.
4. Maximum-opening full-width rear doors and optional side doors swing back parallel to Trailer sides for most efficient loading and unloading.
5. All outside panels are completely weather-lapped, and watersheds above doors prevent leakage.
6. All wiring is protected by conduit and weatherproof junction boxes and connections.

FULLY AUTOMATIC COUPLING

Coupling is completely cab-controlled. The driver simply backs the tractor under the Trailer, which locks the king pin and raises the automatic supports in one motion. There is no cranking.

FULLY AUTOMATIC UNCOUPLING

Uncoupling is quick, safe, and completely cab-controlled. The driver merely operates a hand lever inside the cab to disengage the king pin, then drives away. Supports are automatically lowered and locked in the down position.

FULLY AUTOMATIC CONNECTIONS

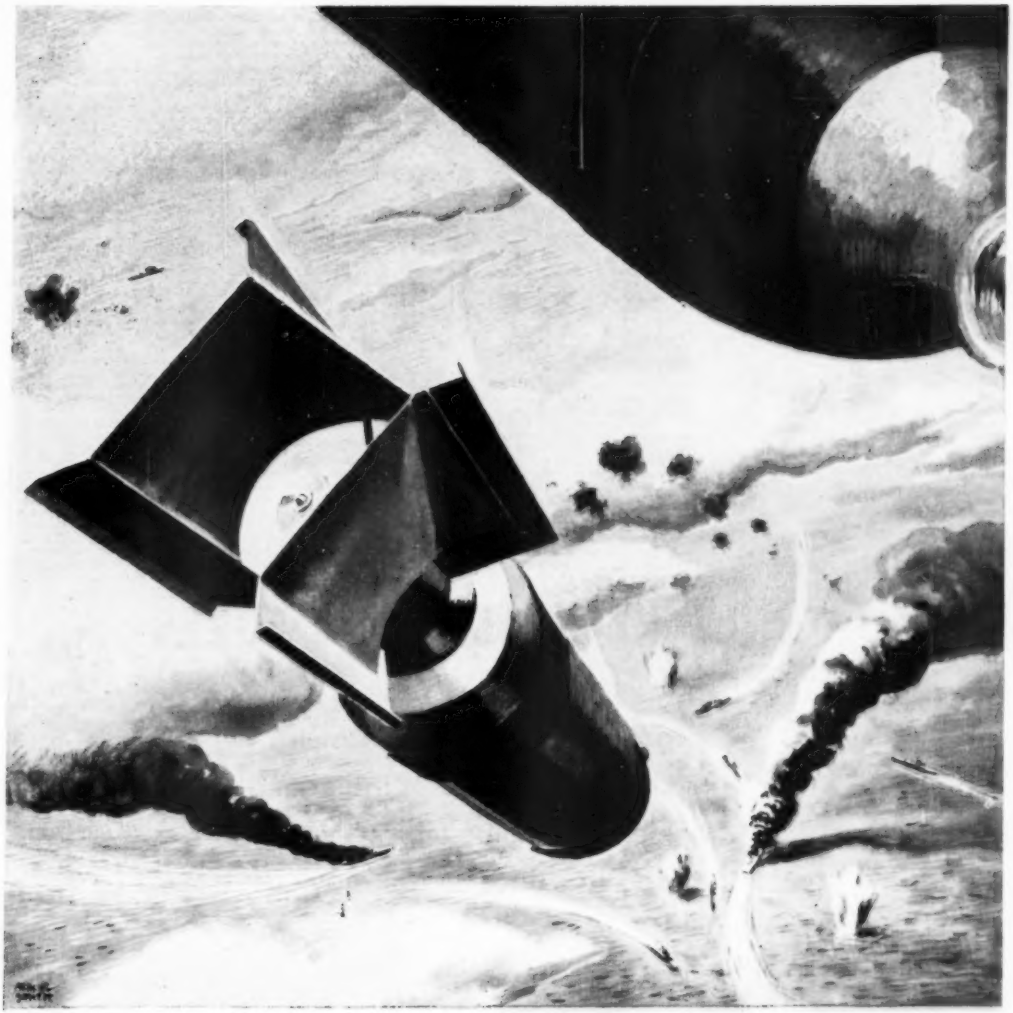
Lights and mechanical brakes are automatically connected through the hollow king pin during coupling, and automatically disconnected during uncoupling. Brakes are set automatically to prevent rolling when Trailer is uncoupled.

HUMAN CONTACT IS ELIMINATED!

THE DRIVER NEVER LEAVES THE CAB!

FRUEHAUF TRAILER COMPANY • DETROIT 32, MICHIGAN

FRUEHAUF *Trailers* "ENGINEERED TRANSPORTATION"



Pin-pointed for its target...

Increasing air speeds and higher level flight pose ever tougher problems for bombing accuracy. Finer and faster target pin-pointing requires bombing mechanisms of extraordinary precision and almost instantaneous action—yet they must function flawlessly under the most rigorous conditions. Not only engineering ingenuity but precision manufacture—to ultra-fine tolerances—is essential. Such are the skills that Arma provides in close collaboration with our Armed Forces in designing, developing and producing the complex instruments that strengthen our defensive striking power. *Arma Corporation, Brooklyn, N. Y.; Mineola, N. Y.; Subsidiary of American Bosch Corporation.*

ARMA ADVANCED ELECTRONICS FOR CONTROL

This Trade Mark

·HECO·

ON ROCKETS • SHELLS • FUZES

and other ammunition metal components assures the armed forces of highest quality, delivery as promised and fair price.

HECO RESEARCH CENTER—
This new experimental and testing laboratory is located in South Denver, apart from the main plant.

Its alert staff and modern equipment will enable the company to broaden and increase its activity in ordnance research and development.

HECKETHORN MANUFACTURING AND SUPPLY COMPANY

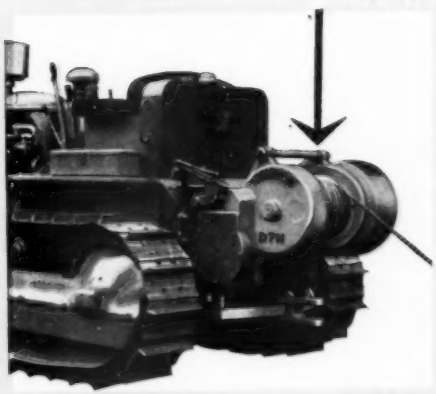
Littleton, Colorado

Contractors to the United States Armed Forces for Rockets, Shells, Fuzes, Research and Development

Winching out, and simultaneously loading, a scraper outfit on a construction project in Tennessee. Hyster D7N towing winch mounted on a Caterpillar D7 tractor equipped with 7S dozer and front cable control.

...Don't let mud **bog down** your operations

HYSTER Winches have *R-E-A-C-H* and *Pull Power* for any construction job...



Hyster Tractor Winches are manufactured for use with Caterpillar D8, D7, D6, D4, D2 and DW-10 tractors. Included are Towing Winches, Worm Drive Winches, Hy-Speed Winches, Oil Well Servicing Winches, two and three drum Tractor Mounted Hoists.

Construction men all know the job insurance provided by a Hyster winch mounted on a Caterpillar diesel tractor. The winch MOVES heavy equipment; RESCUES mud-bogged equipment; INSURES against work stoppage or down-time on any project using equipment; PULLS the tractor itself out of mud or other situations that have immobilized the unit.

Hyster winches and other tractor tools are sold and serviced at more than 700 Caterpillar dealer stores around the world. Consult your dealer. Write for literature.

HYSTER COMPANY

2902-42 N. E. Clackamas, Portland 8, Oregon
1802-42 North Adams Street, Peoria 1, Illinois

MORE THAN 40,000 SATISFIED WINCH OWNERS

ORDNANCE DESIGNERS:

Are you designing—

Engines • Lifts

Vehicles • Transmissions

Hydraulic Steering

EATON ROTOR PUMPS

Give you these important advantages

Silent Operation • Compact Design • Dry Priming

High Efficiency at all Speeds

for

Servo Power • Lubrication • Cooling

Liquid Transfer • Maintaining Pressure

Illustrated literature upon request

EATON MANUFACTURING COMPANY

GENERAL OFFICES: CLEVELAND, OHIO

Pump Division

9771 FRENCH ROAD • DETROIT 13, MICHIGAN

PROTECT Spot-Welded and Hot-Riveted Assemblies from Moisture and Corrosion with..... PITTSBURGH WELDSEAL TAPES!

YOU CAN'T GET BETTER PROTECTION against corrosion from moisture for the spot-welded and hot-riveted assemblies on many military and civilian products than Pittsburgh's Weldseal Tapes.

- **When applied** between members, these tapes flow around heated areas and throughout the seam to form a positive seal that is tightest around the shank of the spot or rivet.
- **Being mildly** conductive, Weldseal Tapes can be used with standard welding equipment, without causing spark or sputter. Their adhesive qualities permit ready application to all reasonably clean metals.
- **Weldseal Tapes** are available in three thicknesses – .015", .025" and .060", and in any width from ½ inch to 12 inches.
- **Samples of these** remarkable tapes are available for experimental work. Our engineers will also be glad to consult with you on sealing problems without cost or obligation.

Pittsburgh Also Offers Nu-CHROMSEAL And FABSEAL Tapes

- **Nu-Chromseal** is a solid, pliable compound in a film of fixed thickness for sealing lap joints or butt seams in metal, wood or fiber.
- **Fabseal** is an impregnated fabric for sealing between metal, wood or fiber members.

• • •

PITTSBURGH PLATE GLASS COMPANY
Industrial Paint Division, Pittsburgh, Pa.

Factories: Milwaukee, Wis.; Newark, N. J.; Springdale, Pa.; Atlanta, Ga.; Houston, Texas; Los Angeles, Calif.; Portland, Ore. Ditzler Color Division, Detroit, Mich. The Thresher Paint & Varnish Co., Dayton, Ohio. Forbes Finishes Division, Cleveland, Ohio. M. B. Suydam Division, Pittsburgh, Pa.

PPG **PITTSBURGH PAINTS**
PAINTS • GLASS • CHEMICALS

PITTSBURGH PLATE GLASS COMPANY

YOU COULD EXPRESS THIS PROBLEM AS

$$\frac{(\text{Temperature}) \times (\text{Corrosion}) \times (\text{Fabrication})}{\text{Cost}}$$

The day after VJ-Day, engineers from a leading appliance manufacturer showed us plans for their postwar refrigerator with a great new feature—*a king-size freeze chest.* But the size increase threatened prohibitive costs. And no combination of metals so far had satisfied the requirements: Fast heat transfer; corrosion resistance; ease of fabrication. They asked, "Can we do it economically in aluminum?"

Now the freezer is simply a sheet metal box with passageways around it to conduct the refrigerant. Knowing that aluminum is an excellent conductor of heat, we suggested that the evaporator be made by brazing aluminum tubing to aluminum sheet. "Sounds good," they said and together we started designs.

Aluminum Research Laboratories found the answer to the first important question: Aluminum is compatible with most commonly used refrigerants.

Alcoa's Process Development Shops suggested an amazingly simple fabrication process, "Place the tubing on flat brazing sheet and furnace braze the assembly. Then form the unit into box shape." The first 25 units were made in this manner—a process so practical and economical that it hasn't changed since. You'll find aluminum freezers, formed by this method, in a great many refrigerators today.

This case is typical of the problems Alcoa men undertake and solve. The same research, test and development facilities stand ready to help you make the best possible use of aluminum for defense needs.

ALUMINUM COMPANY OF AMERICA,
850E Gulf Building · Pittsburgh 19, Pennsylvania.

A business built on co-operation

ALCOA®

ALUMINUM COMPANY OF AMERICA

3-WAY HELP on all finishing problems

1 Technical help on FINISHING METHODS

Do you spray, dip, flow-coat or all three? Sherwin-Williams' wide background of experience in all types of production finishing methods—including electrostatic, automatic and hot spray—may help you solve production problems, whether defense or civilian.

2 Specialized help on FINISHING MATERIALS

Sherwin-Williams Industrial Production Line Finishes include a complete line of primers, reducers and finish coats for air drying and baking, for wood and metal, especially designed to meet civilian production line requirements.

3 Industry-wide experience on FINISHING DEVELOPMENTS

Sherwin-Williams' broad experience in finishes and finishing systems for all types of products provides every industry the benefit of improvements in materials and techniques developed in other specialized fields.

Fit the PRODUCTION LINE too!

How well a finish for use on your defense contracts fits government specifications is only part of the problem. The other part is *how well it fits your existing facilities and production line set-up.*

Sherwin-Williams offers the benefits of industry-wide experience on both counts. In the production of specification finishing materials, this experience extends through two World Wars. In providing technical assistance in converting any portion of your production, with least possible modification in equipment, Sherwin-Williams offers the services of Industrial Finish Specialists with broad experience in both civilian and defense production finishing.

If you have any problems involving the use of finishes to meet government specifications, it will pay you to investigate the help that Sherwin-Williams can offer. Call, wire or write. The Sherwin-Williams Co., General Industrial Division, Cleveland 1, Ohio. Industrial Zone Offices located in Philadelphia, Pa., Newark, N. J., Chicago, Ill., Cleveland, O., Grand Rapids, Mich., Atlanta, Ga., Dallas, Texas and Oakland, California.

SHERWIN-WILLIAMS

INDUSTRIAL FINISHES

for defense production . . . for civilian production

Panel discussions on how casters help reduce the **"Reducible 30%"***

MATERIALS-HANDLING FORUM

Write us how you've used casters to solve specific handling problems. $25.00 will be paid for material used.

A SERIES PUBLISHED BY BASSICK, WORLD'S LARGEST MANUFACTURER OF CASTERS AND FLOOR PROTECTION EQUIPMENT

"FLOATING-HUB" WHEELS PROTECT LOADS

In Bassick's unique "Floating-Hub" construction, the caster wheel, spring-controlled, actually "floats" in the frame, providing mechanical resiliency between the rim and axle.

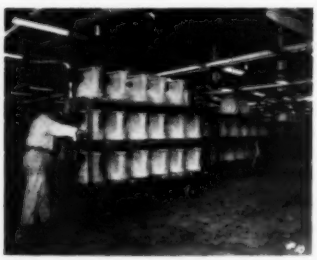
It makes trucks and portable equipment as easy riding as a fine automobile.

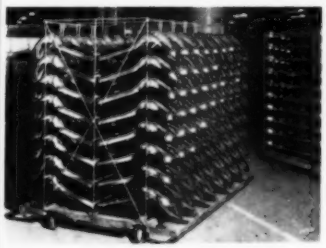
LIQUID SPILLAGE PREVENTED

Slosh and spill of liquids in food carts, portable plating tanks, etc., equipped with Bassick's "Floating-Hub," is minimized.

All Wheels in Contact with Floor at All Times

The "Floating-Hub" construction keeps all wheels in contact with the floor, even on rough bumpy surfaces. The result is an even load distribution and elimination of destructive caster shimmy.





GREATER SECURITY FOR EASILY-DAMAGED LOADS

The smoother, more even ride of "Floating-Hub" safeguards the movement of highly-finished auto bumpers, ceramic products, glass and china ware, loose loads of small parts... innumerable fragile loads.

Shock Absorption Important Advantage of "Floating-Hub"

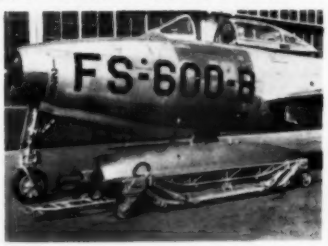
The "Floating-Hub" rides with the punch, backs away with the blow and at the same time starts its climb. This unique ability reduces impact force. That's why it's vitally important on power-pulled trailer trucks.

Full details available upon request

Bassick's "Floating-Hub," in a wide range of sizes (6 to 16 in.) for a wide range of jobs, costs only slightly more than ordinary casters. Write for Catalog 124A. There is a local distributor of industrial supplies handling casters and wheels for every need. Factory engineering assistance readily available. THE BASSICK COMPANY, Bridgeport 2, Conn. *In Canada:* Belleville, Ont.

WEAR ON EQUIPMENT AND CASTERS IS REDUCED

With "Floating-Hub," there is less stress on trucks and dollies because the wheels absorb the bumps. There is less wear on floors because the "Floating-Hub," not the floor, takes the impact. The casters and the equipment last longer.

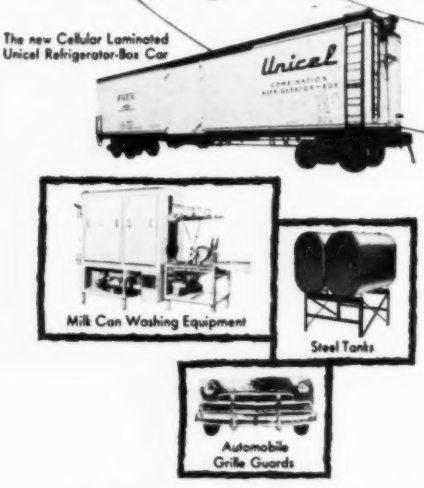


*According to cost analysts, materials-handling (about 30% of total cost) affords about the only real opportunities for cost reduction today.

Bassick
A DIVISION OF STEWART-WARNER
MAKING MORE KINDS OF CASTERS ... MAKING CASTERS DO MORE

INDEX OR TOOTH SPACING HEAD I.C.B.
WORK CONTACT FINGER
MASTER LEAD CYLINDER
L.C.B. MASTER LEAD HEADSTOCK
TAIL STOCK
INDICATOR ARM ASSEMBLY
CARRIAGE
HAND WHEEL
MASTER CYLINDER FOLLOWER ARM
BASE
LOCATE AND EVALUATE GEAR ERRORS
QUICKLY and ACCURATELY
Errors in each of the several gear characteristics can be quickly analyzed and evaluated on the Red Ring Universal Gear Checker.
This instrument with 5 interchangeable heads indicates errors in tooth size, spacing, helix angle, lead, eccentricity, parallelism and wobble. This Checker is rugged enough for the production shop—sensitive enough for the gear laboratory—simple enough for the average shop man to use effectively. No special skill is required—ideal for the rapid inspection of mass-produced gears.
For more detailed information and specifications ask for Bulletin C-51-6.
SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORM
NATIONAL BROACH & MACHINE CO.
5600 ST. JEAN . . . . . DETROIT 13, MICHIGAN
WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

Widening Circles of Economic Influence



The new Cellular Laminated Unicel Refrigerator-Box Car

America's need for increased production—for overall industrial effort—has never been greater.

Like hundreds of other American manufacturers, Pressed Steel Car Company is helping to fill that need. Besides making the wide range of products you see in this advertisement—and making them well—Pressed Steel Car Company is constantly alert to new production possibilities, newer and more diversified products and markets.

This "widening of the circle" is not only important to America's progress and prosperity. It is equally essential to the nation's defense.

PSC PRESSED STEEL CAR COMPANY, INC.

6 No. Michigan Avenue, Chicago, Ill.

230 Park Avenue, New York 17, N. Y. • 25 Broad St. (Export) New York 4, N. Y. • 314 No. Broadway, St. Louis 2, Mo.

Mt. Vernon Car Manufacturing Division • Solar Sturges Manufacturing Division • Jahn Trailer Division
Erie Manufacturing Division • Unicel Division • Chicago Steel Tank Company • Rice & Adams Equipment Division

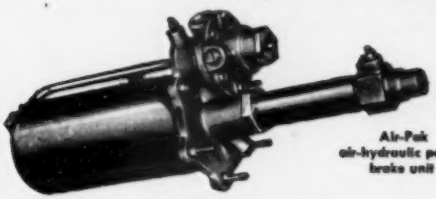
Either Way – YOU'RE ON THE ROAD TO BETTER POWER BRAKING!

There's no need to be puzzled about the question of efficient power braking for *any commercial vehicle*. Where the preference is for a hydraulic system, Hydrovac, with over two and a half million installations, has proven itself the undisputed leader in its field. And for vehicles where air actuated brakes are the choice, the new Bendix Air-Pak air-hydraulic power braking unit is foremost in its field.

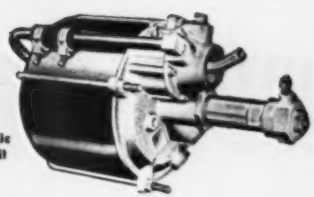
Air-Pak, similar in design and principle to the Hydrovac, changes air pressure into hydraulic pressure by means of two direct connected pistons, thus combining all the well proven advantages of hydraulic brake action with an air brake system.

Products of twenty-five years of practical braking experience, these outstanding power braking systems offer faster, more positive and better controlled braking. And in both the vacuum and the air actuated units, brakes can be applied instantly by foot power alone—a safety factor of tremendous importance. Remember, regardless of size of vehicle or whether your preference is for vacuum or air actuated brakes, for the industry's finest power braking systems—specify Bendix* Hydrovac* or Bendix Air-Pak.

*REG. U. S. PAT. OFF.



Air-Pak
air-hydraulic power
brake unit



Hydrovac
vacuum-hydraulic
power brake unit

BRAKING HEADQUARTERS for the AUTOMOTIVE INDUSTRY

BENDIX · PRODUCTS DIVISION · SOUTH BEND

Export Sales: Bendix International Division, 72 Fifth Ave., New York 11, N.Y. • Canadian Sales: Bendix-Eclipse of Canada, Ltd., Windsor, Ontario, Canada

Bendix Aviation Corporation

Bendix Products Division

PRATT & WHITNEY

FIRST CHOICE FOR *Accuracy*

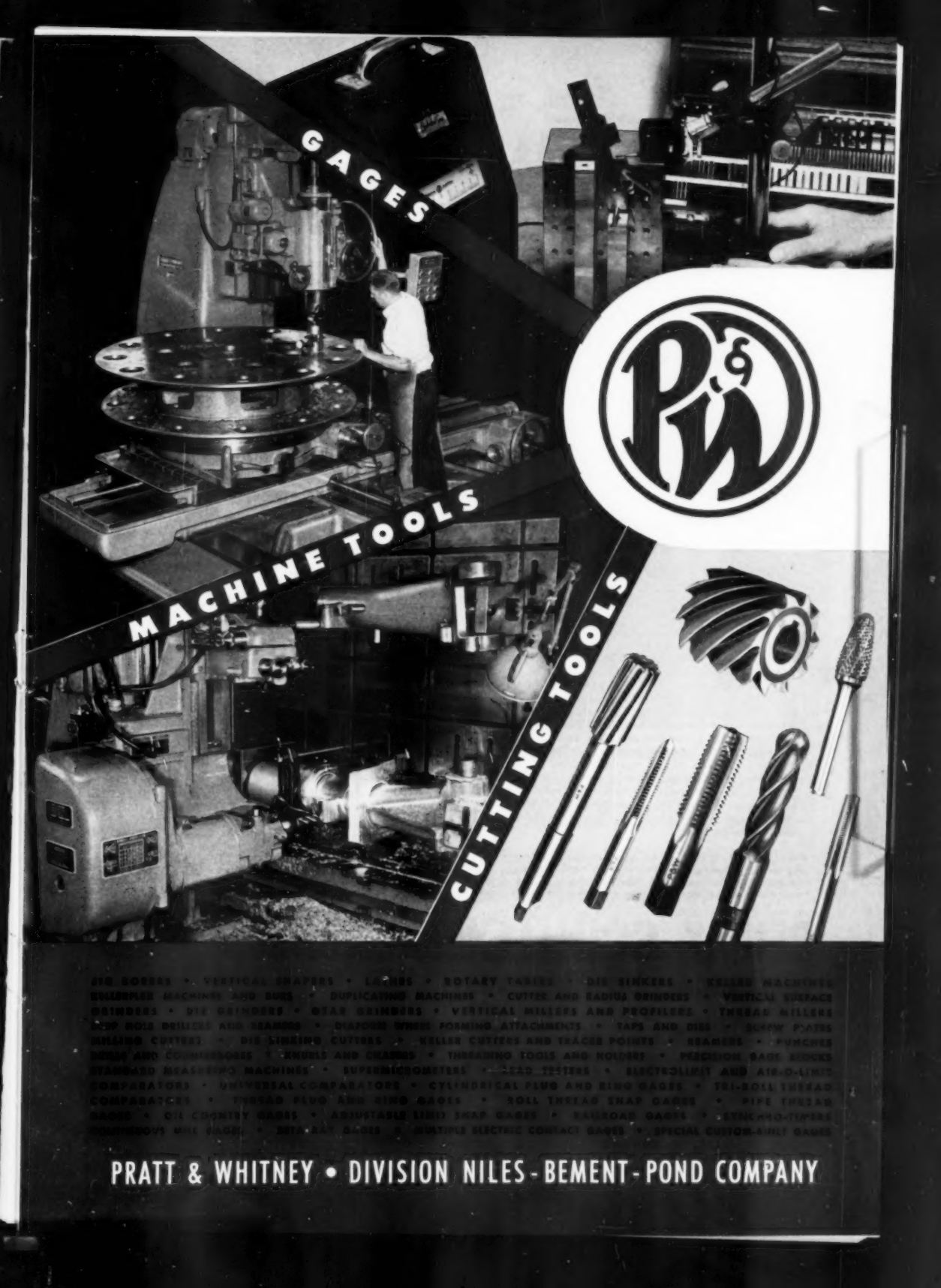
Backbone of America's industrial might is her power to mass produce, to create more and better things at lower cost. Modern mass production, involving the highly accurate duplication of components, depends in turn on the basic ability to measure with millionth-of-an-inch accuracy. This ability is, to a great degree, the result of Pratt & Whitney's establishment of the standard inch, accurate to millionths, and the creation of the Standard Measuring Machine nearly 70 years ago.

Today, the highly integrated Pratt & Whitney plant of over 1,060,000 square feet houses a wealth of skill, knowledge and experience. The expert craftsmen and specialists in the several divisions of this unique organization . . . working as a team and with complete interchange of technical knowledge and proficiency . . . design, develop, prove and produce a wide variety of Pratt & Whitney precision Machine Tools, Cutting Tools and Gages . . . the finest ever made to meet the exacting demands of industry.

Extreme accuracy . . . to a degree once believed impossible . . . is today a vital industrial necessity in both small shops and huge production plants. And always, your ***First Choice For Accuracy*** is Pratt & Whitney.

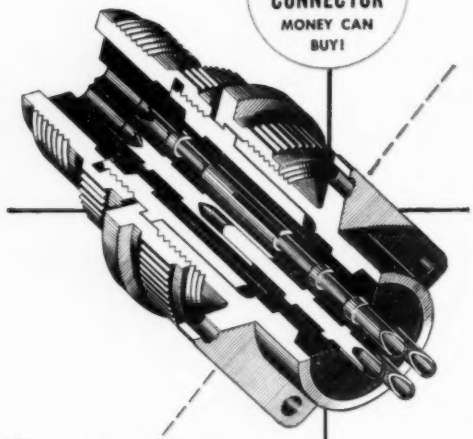
PRATT & WHITNEY
DIVISION NILES-BEMENT-POND COMPANY
WEST HARTFORD 1, CONNECTICUT, U. S. A.

First Choice *for Accuracy*



PRATT & WHITNEY • DIVISION NILES-BEMENT-POND COMPANY

The Finest
ELECTRICAL CONNECTOR MONEY CAN BUY!



SCINFLEX **ASSURES LOW MAINTENANCE BECAUSE IT PERMITS SIMPLICITY**

When operating conditions demand an electrical connector that will stand up under the most rugged requirements, always choose Bendix Scinflex Electrical Connectors. The insert material, an exclusive Bendix development, is one of our contributions to the electrical connector industry. The dielectric strength remains well above requirements within the temperature range of −67°F to +275°F. It makes possible a design increasing resistance to flashover and creepage. It withstands maximum conditions of current and voltage without breakdown. But that is only part of the story. It's also the reason why they are vibration-proof and moisture-proof. So, naturally, it pays to specify Bendix Scinflex Connectors and get this extra protection. Our sales department will be glad to furnish complete information on request.

• Moisture-Proof • Radio Quiet • Single Piece Inserts • Vibration-Proof • Light Weight • High Insulation Resistance • High Resistance to Fuels and Oils • Fungus Resistant • Easy Assembly and Disassembly • Fewer Parts than any other Connector • No additional solder required.

BENDIX SCINFLEX
ELECTRICAL CONNECTORS

Bendix

SCINTILLA MAGNETO DIVISION of
SIDNEY, NEW YORK

Bendix AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

FACTORY BRANCH OFFICES: 118 E. Providencia Ave., Burbank, Calif. • Stephenson Bldg., 6560 Cass Ave., Detroit 2, Michigan • Brouwer Bldg., 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 582 Market Street, San Francisco 4, California

METALWORKING MACHINERY

Cold Headers for Bolts, Screws, etc.

Bolt Head Trimmers

Screw Thread Rolling Machines

Nut Forming Machines

Nut Tapping Machines

Screw Slotters

Rivet Drillers

Power Presses of all Kinds

Eyelet Machines

Small Arms Ammunition Machines

Collapsible-Tube Machines

Thread Rolling Machines for Shells

Wire Drawing Machines

Rolling Mills for Sheets and Strips

Rod and Tube Mills

Flatteners and Straighteners

Gang Slitting Machines

Swagers, Pointers, Coilers, Winders, etc.

Special and Miscellaneous Machines

WATERBURY FARREL
FOUNDRY AND MACHINE COMPANY
Waterbury Connecticut, U. S. A.

SALES OFFICES:
CHICAGO CLEVELAND MILLBURN, N. J.

Filling the Breach

at 250 Rounds Per Hour

W-S SEMI-AUTOMATIC SHELL BANDING PRESS

For Conventional Bands or Powdered Metals

Here's a machine that's setting new daily production records right at the shell banding station . . . with rates up to *250 per hour* on 90, 105, 120, and 155 MM ordnance.

With exception of the loading operation, control is entirely automatic. Pressing the "cycle-start" button causes twenty-four synchronized rams to move in radially upon the shell, exert preset pressure, and dwell for an automatically timed period. Another push-button operates the automatic air-ejector.

Where unit work pieces are large and heavy, this kind of mechanized operation and handling pays off in increased man-hour productivity even over extended work periods. The proven design provides the maximum in trouble-free availability and low maintenance . . . You get less rejects. Capacity 500 Tons . . . overall height 3 ft. . . . floor space required 8' 6" x 6' 0".

Write for complete details of this latest revolutionary development in our national preparedness machine.

WATSON-STILLMAN
ESTABLISHED 1848

HYDRAULIC MACHINERY DIVISION

Factory and Main Office:
165 Aldene Rd., Roselle, N. J.

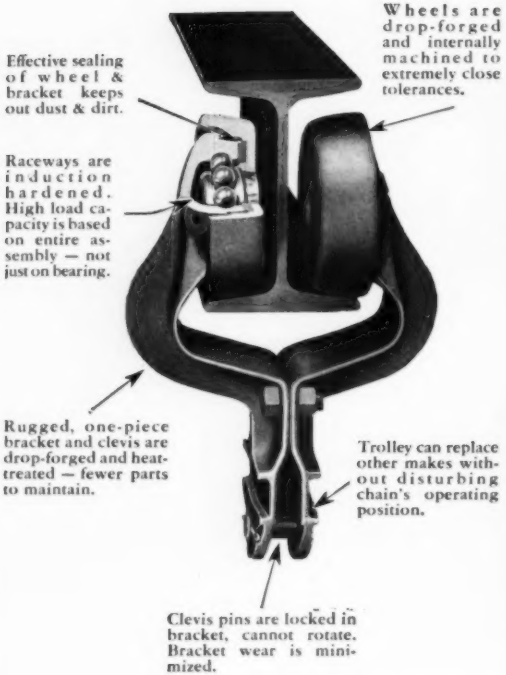
W-S Completeline

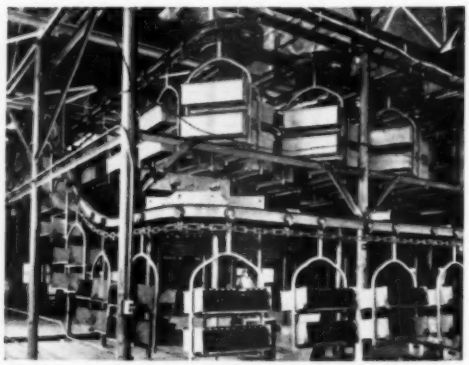
Branch Off.: 228 N. LaSalle, Chicago Ill. • Manufactured in Canada by Canadian-Vickers, Ltd., Montreal

HYDRAULICS . . . THE SHORTEST DISTANCE FROM PRODUCTION TO PROFIT

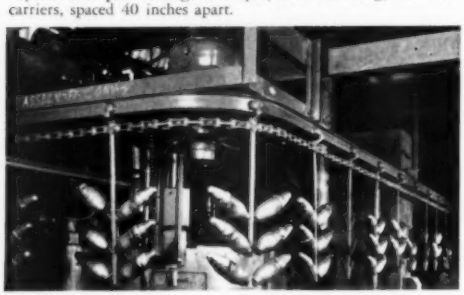
When you buy TROLLEY CONVEYORS why not get BOTH?

Superior components PLUS Engineering ingenuity


Effective sealing of wheel & bracket keeps out dust & dirt.
Wheels are drop-forged and internally machined to extremely close tolerances.
Raceways are induction hardened. High load capacity is based on entire assembly — not just on bearing.
Rugged, one-piece bracket and clevis are drop-forged and heat-treated — fewer parts to maintain.
Trolley can replace other makes without disturbing chain's operating position.
Clevis pins are locked in bracket, cannot rotate. Bracket wear is minimized.



Building 3.5-inch rockets, modern version of World War II bazooka, with the help of Link-Belt Overhead Trolley Conveyors. This parts storage conveyor, 600 feet long, has 180 carriers, spaced 40 inches apart.



Steel bodies for these 3.5-inch rockets are carried on this 112-foot-long Link-Belt Overhead Trolley Conveyor. The carriers, spaced 50 inches apart, were also made by Link-Belt.

You can make your overhead trolley conveyor dollars go farther by calling in Link-Belt while you're still in the planning stage. Link-Belt makes the finest trolley on the market today. Equally important, our specialists can draw on the world's largest, most varied background of conveying and power transmission application.

Bringing parts to workers and taking them away. Drawing raw materials from stock at correct intervals. Synchronizing operations to eliminate bottlenecks.

Link-Belt Overhead Trolley Conveyors do all these jobs to release valuable manpower for productive work . . . to increase output. And they free floor space, too.

Why not have a Link-Belt engineer help you and your consultants plan peak production results? Write for Book 2330 for all the facts.

LINK-BELT

OVERHEAD TROLLEY CONVEYORS

LINK-BELT COMPANY: Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities. 12,411-A

Uncle Sam Buys Many Rotating Bands from WOLVERINE

These rotating bands are made of Wolverine seamless tube of either copper or gilding metal in the following sizes: 20mm, 60mm, 75mm, 76mm, 90mm, and 105 mm. They are produced under most exacting specifications.

Wolverine engineers are continually carrying on research in the development and production of many items required for the defense program, and in past emergencies Wolverine has been one of the many important sources for military equipment which called for tubing in some form or another.

Wolverine's long experience exclusively in tube making—dating back through several emergencies—embodies a specialized skill and talent to meet the most rigid demands in the production of tubing and tubular parts.

also

STEEL PRIMER TUBES

We have produced quantities of steel primer tubes—both in low carbon steel and in brass in accordance with government specifications.

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Calumet & Hecla Consolidated Copper Company
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Manufacturers of seamless, nonferrous tubing
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If it's tubular, we can help you produce it. Send us your prints for consideration and quotation.

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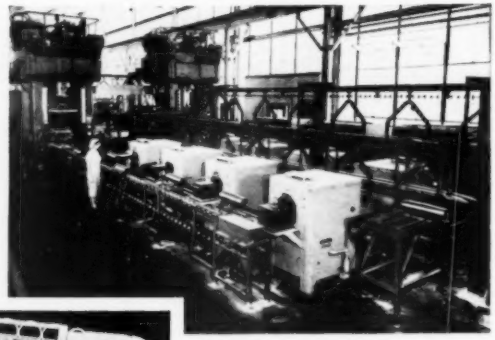
Sales Offices in Principal Cities

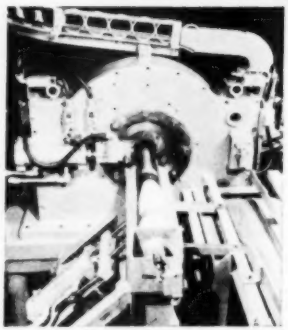
Ordnance Machinery by W. F. & JOHN BARNES

Here are only a few of the pieces of equipment built by W. F. and John Barnes for ordnance. In addition to many other individual pieces we have designed and built an entire plant for the automatic production of 155 mm high explosive shells. Other projects of similar magnitude are now in progress. We will be glad to work with you on any machining or processing problems pertaining to ordnance.



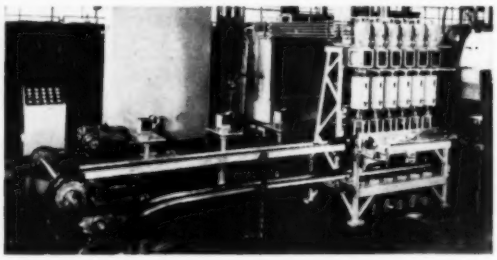
Shell Banding Machinery

Banding equipment is available for a wide variety of shell sizes. The photograph illustrates a 105 M M shell ejected from the banding head and ready to be automatically transferred to a take-away conveyor. The automatic features and gentle handling methods of the Barnes Banding Machine has permitted successful banding of live ammunition in renovation programs. Notching heads, band resizers, band gaging units, band deburring equipment and conveyors have been developed as accessories to insure correctly banded shells. New shells can be banded at rates up to 300 shells per hour. The machines are also capable of banding shells where specifications call for a minimum content of metal in the band.



Special Conveyors

Special conveyors of all types have been designed for various processing arrangements. The illustration above represents but one example. Note the three different types of conveyors. In addition, we design and build all types of chip conveyors.



Cavity Facing Machinery

Other developments for ordnance work include machines for facing the explosive shell charge. This equipment can be furnished to accommodate shells from the 57 M M to the 8 inch including 2.36, 3.5, 4.5 rockets, and the 4.2 mortar. Complete hydraulic operations, an absence of electrical controls and motors within the barricaded cubicle and full safety interlocks have eliminated the need for an operator inside the hazardous area. Signal lamps are included to inform the operator of the machine's performance. The machine shown was designed for the 3.5 rocket. The Barnes transfer fixtures which carry groups of six rockets through the facing operation are used throughout the load line for other operations.

Electrical Circuits and Controls

Complete electrical circuits and controls have been designed by W. F. and John Barnes for a wide variety of installations. Shown to the right is the control desk. The desk has switches and pushbuttons for manual operation in regular or special sequence when desired. Manual switches also permit sectionalizing the machines so that only certain parts will work if desired. Lamps on the vertical face of the desk burn bright or dim in sequence to keep the attendant informed of the status of the machines functions and to give notice of any misoperation.

Free Additional Literature

is available on all Barnes Ordnance equipment. Since it is impossible to give the complete scope of operation in this restricted space, we invite you to write for the complete Barnes Ordance book. Ask for bulletins 0000.

W. F. & JOHN BARNES

W. F. and JOHN BARNES

PROCESS EQUIPMENT DIVISION 328 SOUTH WATER STREET, ROCKFORD, ILLINOIS

Equipped with a DoMor elevating loader, this No. 12 Motor Grader loads "Cat" W10 Wagons, pulled by "Caterpillar" DW10 Tractors, with 1,950 cu. yds. of fill per day on a road-building job near Carmi, Illinois.

All-round road builder

THE "Caterpillar" Diesel No. 12 Motor Grader walks off with the honors where strength and versatility are called for in tough grader jobs.

Rugged, all-"Caterpillar" construction, ample power and traction, full blade-angle range, simplicity of operation—all these factors give the No. 12 its big work capacity and versatility on all kinds of highway building and maintenance.

"Old Reliable," as road men call this famous grader, is not only a master hand at rough grading, ditching, bank-sloping, spreading and finishing. Equipped with a DoMor elevating loader, it also doubles as an efficient loading machine.

Good equipment is valuable property these days. It's worth taking care of. A few minutes of proper maintenance daily will pay off in many extra hours of trouble-free work life.

CATERPILLAR, PEORIA, ILLINOIS

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TRACTORS • MOTOR GRADERS
EARTHMOVING EQUIPMENT

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are ready to serve you!

ALL FULLY INFORMED ON SPECIFICATIONS
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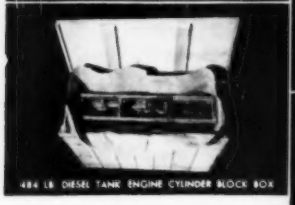
IMMERSION HEATER BOX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FIELD RANGE CRATE

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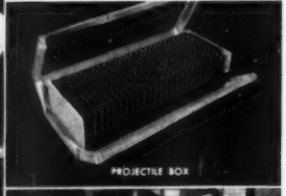
TYPICAL WIREBOUND OVERPACK


PROJECTILE BOX

PRACTICE BOMB CRATE

Wirebound
BOXES & CRATES
Users names on request

Bundyweld "Doodles"

to jog a designer's imagination

Put Bundyweld Tubing into that part of yours and get improved performance. Put Bundyweld through your production lines and get lowered fabrication costs.

If you need design or fabrication help, depend on Bundy skills, the industry's finest, to save you time, materials, money. If you choose, have Bundy fabricate and ship your parts—in any quantity and on time. Write for catalog today. ***Bundy Tubing Company, Detroit 14, Michigan.***

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DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting point
High endurance limit
Extra-strong
Shock-resistant
Ductile

Lightweight
Machines easily
Takes plastic coating
Scale-free
Bright and clean
No inside bead
Uniform I.D., O.D.

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . . continuously rolled twice around laterally into a tube of uniform thickness, and passed through a furnace. Copper coating fuses with steel. Presto . . . Bundyweld, double-walled and brazed through 360° of wall contact.

← **NOTE** the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

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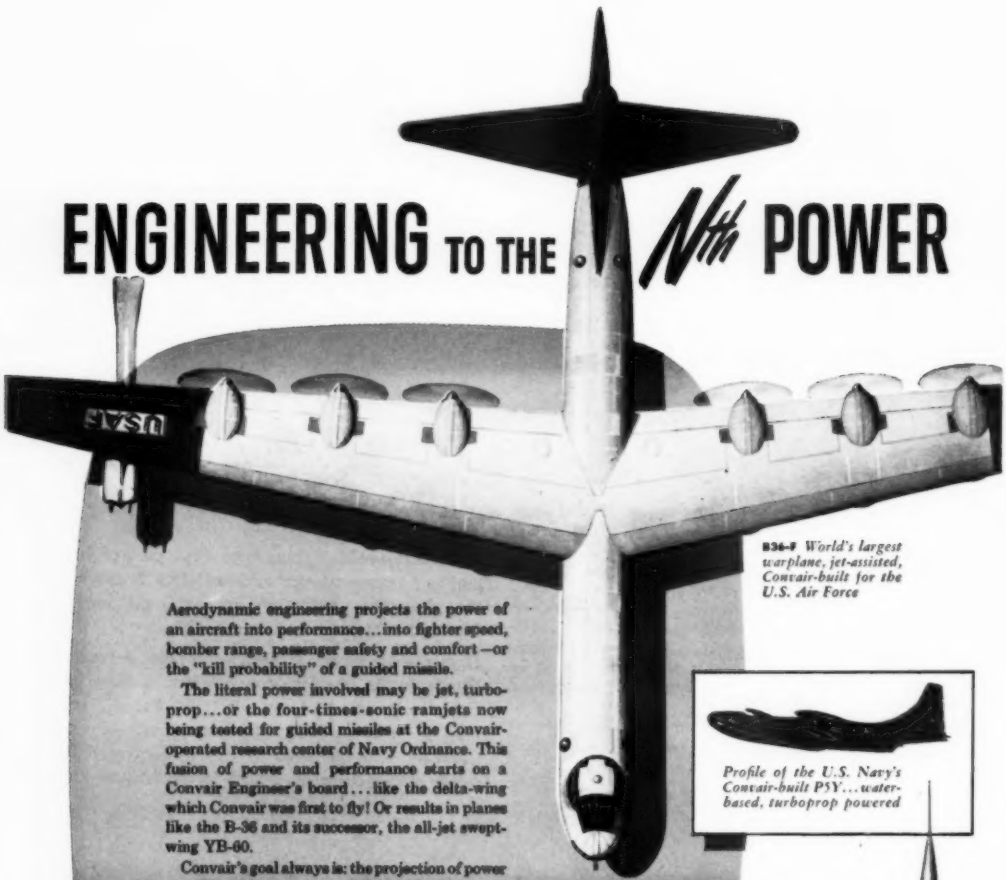
ENGINEERING TO THE *Nth* POWER



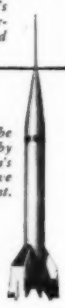
B36-P *World's largest warplane, jet-assisted, Convair-built for the U.S. Air Force*

Aerodynamic engineering projects the power of an aircraft into performance... into fighter speed, bomber range, passenger safety and comfort—or the "kill probability" of a guided missile.

The literal power involved may be jet, turboprop... or the four-times-sonic ramjets now being tested for guided missiles at the Convair-operated research center of Navy Ordnance. This fusion of power and performance starts on a Convair Engineer's board... like the delta-wing which Convair was first to fly! Or results in planes like the B-36 and its successor, the all-jet swept-wing YB-60.

Convair's goal always is: the projection of power to achieve the *maximum* degree of performance. The maximum, the Nth degree of air power... *the Nth Power!*

Profile of the U.S. Navy's Convair-built P5Y... water-based, turboprop powered



Guided missiles will be mass-produced by Convair in America's first exclusive missile plant.

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CONSOLIDATED VULTEE AIRCRAFT CORPORATION

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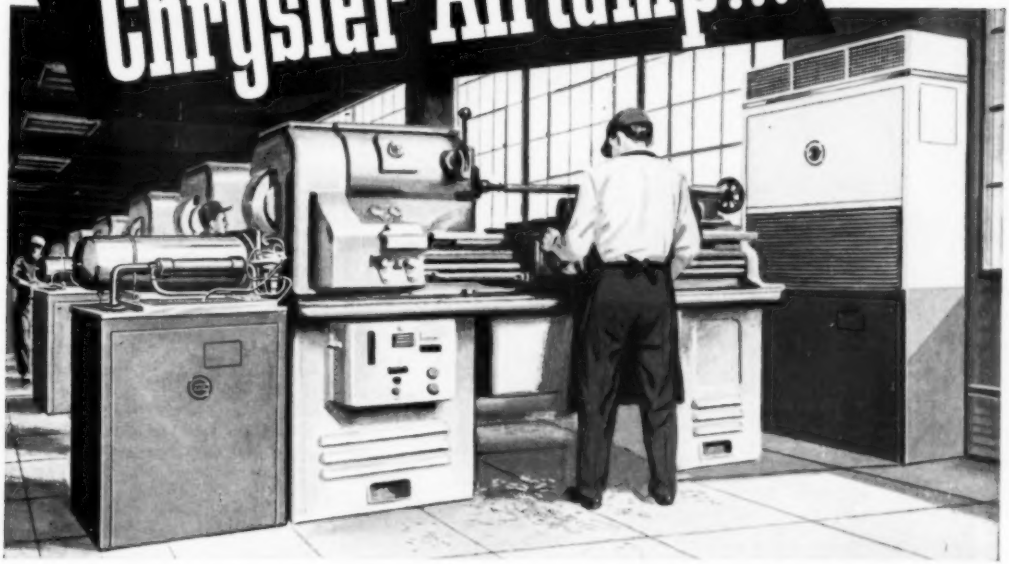

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TAKE THE HEAT OFF HIGH SPEED PRODUCTION

Uncontrolled temperatures play havoc with high speed production schedules. Workers and machines are less efficient, both fail to give peak performance unless temperature levels are kept at a constant degree. Here's where Chrysler Airtemp can help. When you install Chrysler Airtemp temperature-control equipment in your plant, production will increase. Costly breakdowns and failures—of men and machines—will be averted. Chrysler Airtemp products are factory engineered and warranted to give effective temperature-control. Mail coupon today for full details on how Chrysler Airtemp can bring you the benefits of proper temperatures in your operations.

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Handles all types of coolants from aqua solvents to heavy tapping and hydraulic oils. Installation permits one cooler to service one or several machines.

PACKAGED AIR CONDITIONERS*

Compact, easily installed. Six available sizes of 2, 3, 5, 11 and 15 ton. Units are factory-assembled and tested.

***COMPLETE FIVE-YEAR WARRANTY**

Compressor units in all "Packaged" Air Conditioners and Liquid Coolant Coolers carry an optional five-year warranty, through dealers. This warranty covers compressor replacement, freight to and from the factory, plus a labor allowance for removing and installing compressor assemblies.

Chrysler Airtemp

AIR CONDITIONING • HEATING • COMMERCIAL REFRIGERATION

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CHRYSLER AIRTEMP — A VITAL FORCE IN NATIONAL DEFENSE

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Please send me information showing how Chrysler Airtemp can help me boost production with "packaged" Air Conditioners and Liquid Coolant Coolers.

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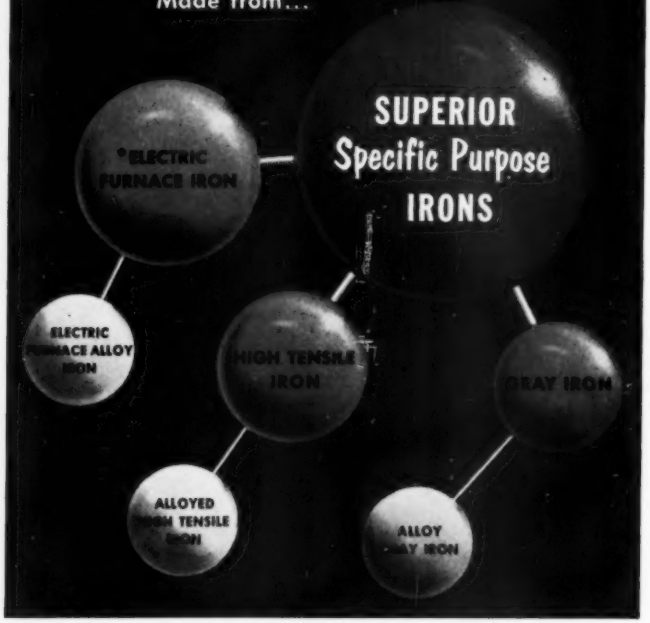
Superior Special Purpose Castings

Made from...



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- Three mechanized continuous mold and sand-handling conveyor systems...
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BEST EVIDENCE of Superior's completely dependable facilities and services are the prominent manufacturers in many industries whose castings, year after year, are engineered and produced by Superior. It could pay you, too, to consult with Superior...today!

* Write today for interesting booklet describing Superior's unique Electric Furnace facilities.

and here's proof...

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ATOMIC ENERGY

SUBMARINE REACTOR

The U. S. Atomic Energy Commission recently authorized construction at West Milton, N. Y., of General Electric's land-based prototype of an atomic power plant for submarines.

Design and construction of this nuclear reactor is under the direct supervision of the Knolls Atomic Power Laboratory operated in Schenectady, N. Y., by the General Electric Company for the Commission. The reactor will be located on the 4,000-acre site already owned by AEC in West Milton near Schenectady. Construction of buildings and facilities to house the reactor and related equipment will be accomplished by direct contracts under the Schenectady operations office of the Commission.

The prototype will be used for final development work leading to construction of an intermediate-energy reactor for propulsion of a submarine. The Electric Boat Company of Groton, Conn., is associated with General Electric Company as the submarine builder on this project and is also serving in a similar capacity on a prototype reactor of different design which is being constructed by the Westinghouse Electric Corporation at the National Reactor Testing Station in Idaho.

During all phases of design of the West Milton project careful attention has been given to the safety of operating personnel and off-site areas. The reactor will be housed in a steel sphere two hundred and twenty-five feet in diameter similar to structures widely used in the chemical and petroleum industries. This special type of reactor building is being designed to provide, during preliminary test operations, protection additional to the many safety controls of the reactor itself.

Negotiations are presently under way for the design and construction of the sphere. Conventional construction work at the site will be done under fixed-price contracts awarded as a result of competitive bidding.

The land-based prototype at West Milton will contribute research, development, and operating data important to the design of future reactors for producing power for industrial and commercial purposes.

The Knolls Atomic Power Laboratory also is engaged in furnishing technical assistance to the plutonium production center at Hanford, Wash., and to the Savannah River Plant which is under construction by E. I. du Pont de Nemours & Company. *(Continued on p. 908)*

Solve the need for

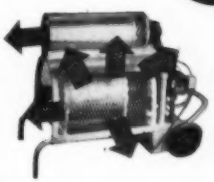
SPOT HEAT INSTANTLY!

Whenever, wherever you must provide temporary, emergency heat, you can depend on Silent Glow's Model RF to do an effective, economical job to insure more comfortable working conditions in winter weather . . . de-ice equipment . . . preheat areas.

Easy to transport, just wheel the unit where you want it . . . easy to operate, just flick the switch (no torch, match or open flame required). In five minutes you'll have all the heat you need. Unit delivers 168,000 BTU per hour.

SAFE . . . all moving parts and heated surfaces fully protected . . . unit cannot be tipped over accidentally . . . fire goes out immediately when switch is snapped off or power is shut off. CLEAN . . . burns without soot, smoke or fumes . . . no carbon monoxide or unburned hydrocarbons. ECONOMICAL . . . low original cost, low operating cost . . . 100% utilization of fuel, uses No. 2 fuel oil.

Mail coupon today for complete information about the Model RF and other Silent Glow Portable Heaters.



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More than 10,000 Silent Glow Heaters on duty in the United States and abroad . . . approximately 100 functioning perfectly in Alaska's extreme temperatures.

Use the MODEL RF to—

- Provide more comfortable working conditions in warehouses, machine shops, on loading platforms and docks . . . for outdoor repair crews, etc.
- De-ice vehicles, machinery, ship decks, etc.
- Pre-heat freight cars, engines, etc.
- Thaw frozen transmissions, wheels, gears, etc.
- And for a wide range of other applications where it is important to provide spot heat.

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PORTABLE

Manufactured by pioneers in the oil burner field.

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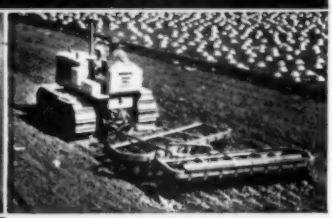

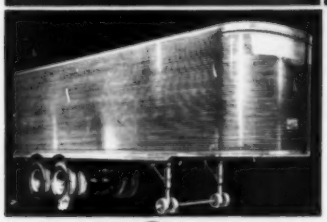

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Are these self-lubricating bearings the answer to *your* problem? Write today for Bulletin 151.

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RADIOISOTOPES IN CANCER RESEARCH

Radioactive isotopes have proved extremely potent tools for cancer research. By cancer research is meant the search for basic facts bearing on the nature of abnormal and uncontrolled growth processes and the use of those facts in solution of the problems of diagnosis and treatment of cancer.

Thus such diverse problems as protein synthesis, the mechanism of cell division, the nature of radiation injury, and the effects of hormones on normally growing as well as cancerous cells are among those coming within the scope of cancer research.

Obviously the solution of any problem is greatly simplified if one or more of the factors can be clearly identified throughout the reactions involved. With the aid of the tagged atoms of radioisotopes, such identification of atoms and molecules can be made both *in vivo* and *in vitro*.

Furthermore, this identification may be made in most instances without alteration of the character or course of the reaction being studied, since the chemical properties of radioisotopes are identical with those of the normal element and since the radiations characteristic of a given element can be detected in amounts so small as not to influence the reaction.

In certain fields of investigation, stable isotopes, such as deuterium, have proved useful, but the greater ease of detection of the radioisotopes and their great number have made them particularly valuable.

The means of detection of radioactive atoms and their approximate quantitative measurements are relatively simple: the darkening of photographic emulsions, the ionization of air or other gases as measured by the electroscope or the Geiger-Muller tube and counter, the emission of photons from such substances as anthracene and their pickup by photomultiplier tubes.

Each method used in study of biologic processes by tracer techniques has certain specific advantages for particular situations, and improvements are being rapidly made in instrumentation.

The ready availability of isotopes came about with the development of the chain-reacting pile. The Atomic Energy Commission is fulfilling its responsibility in promoting the use of this new source of energy for peaceful and humanitarian purposes as well as safeguarding the national security through its weapons program. From the Commission's establishment at Oak Ridge thousands of shipments of radioisotopes are made annually to research workers both in this country and abroad.

The Atomic Energy Commission recognizes the special value to the complex field of cancer research offered by

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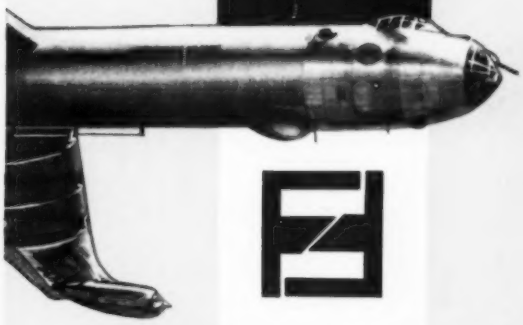

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isotopes and has made them available at well below production costs when they are to be used in cancer research, diagnosis, and therapy. It further recognizes that radioactive substances even in small amounts are hazardous, posing problems not only in their use but in their disposal after use.

Consequently certain criteria for safe handling must be met by those desiring to use isotopes before allocation can be made. Since the field is relatively new, and those familiar with the techniques were at first only a few, a school for isotope handling has been established at Oak Ridge.

The chemical elements are rarely important as such in complex biologic problems. Rather, compounds are of major significance. Radioactive isotopes are, therefore, much more serviceable when incorporated into compounds than when used in elemental form. In fact, the activity of biologic processes is such that even were an isotope to be introduced into a living system in elemental form it would shortly be incorporated into organic compounds in most instances.

This incorporation of radioisotopes into more complex compounds by living tissue has very real value from the standpoint of production of compounds useful for research. While simpler compounds containing radioactive atoms can be produced by standard methods of chemical synthesis, the more complex compounds can best be produced by biosynthesis. Thus, digitalis with radioactive carbon incorporated into the molecule is formed when radioactive carbon in the form of carbonate or carbon dioxide is provided to the foxglove plant. Long lists of complex substances are now available through various types of biosynthetic processes.

In the field of cancer research carbon 14 is probably the most widely useful radioactive isotope, largely because carbon is such a key substance in almost all biologic systems. Carbon 14 gives off a relatively poorly penetrating beta particle with transition to nitrogen 14. Its long half-life of 5,900 years makes it an ideal material with which to work.

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MIL-C-972, Grade II (Superseding 52-C-18 Grade II)	Klad Kote 122
MIL-C-6708, Type I (Superseding AN-C-52b Type I)	Klad Kote 102
MIL-C-6708, Type II (Superseding AN-C-52b Type II)	Klad Kote 252
AN-C-124a, Type I	Klad Kote 124
AN-C-124a, Type II	Klad Kote 224
AXS-673, Rev. 2	Klad Kote 103
AXS-1759, Grade I	Klad Kote 171
AXS-1759, Grade II	Klad Kote 172
AAF 14156, Amend. 1	Klad Kote 356
USA 2-122	Klad Kote 322
USA 2-121	Klad Kote 221
AN-VV-C-576b, Type I	Klad Kote 376
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Anti-Seize Compounds: MIL-C-5544 – JAN-A-669.
Aircraft Cleaning Compounds: Army Air Force AAF 20015-E – Navy Aero C-147.
Non-Inflammable Hydraulic Fluid: Navy BuAer MIL-F-7083
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Research for Air Power

The Problem of Developing Weapons for Today's Aircraft

Lieut. Gen. Earle Everard Partridge, Commanding General, Air Research and Development Command, Baltimore, Md., whose photograph appears on the front cover of this issue, is a veteran of both World Wars.

Born at Winchendon, Mass., in 1900, he enlisted in the Army in 1918, was assigned to an Engineer regiment, and took part in the Argonne offensive. Upon his return to this country he entered the U. S. Military Academy at West Point, being graduated in 1924.

General Partridge, then a second lieutenant, completed primary and advanced flying training at Brooks and Kelly bases in Texas and was awarded the Distinguished Aërial Gunner's Medal.

He served for a time as a member of the Air War Plans Division and then became a member of the War Department General Staff.

In 1943 he went overseas to join the Northwest African Air Force and later became chief of staff and deputy commander of the Fifteenth Air Force under Gen. James H. Doolittle. In 1944 he became deputy commander of the Eighth Air Force and then assumed command of the Third Air Division.

After service in Europe, Okinawa, and the U. S., he was assigned to the Fifth Air Force in Japan and commanded this unit during the Korean campaign. He assumed his present command on June 24, 1951.

IT is beyond argument that air power, while by no means the answer to every military problem, is the most convincing expression of military combat effectiveness.

But the universal recognition of the importance of air power in our atomic age does not in any way help to solve the complex problems that are inherent in any attempt to bring planes and armament into step with the latest advances in the constantly expanding field of aëronautical science.

Aërial Revolution

Consider for a moment the revolution in air warfare brought about by the jet engine. Jet planes can travel faster and climb higher than any planes in aviation's brief history. They can be hurled through space at speeds near and even greater than the speed of sound. They can achieve altitudes of 40,000 or 50,000 feet.

Where it is impossible for the human mind and body to master such an extraordinary stratospheric environment in split-second intervals, ground and air instruments must be devised to aid jet pilots in the accomplishment of their amazingly difficult assignments.

The ideal solution would be a collection of simple gadgets that could easily and quickly be utilized by today's airmen in normal flying operations, particularly in crisis situations. But simplicity in aircraft construction, equipment, and armament was one of the marks of aviation's childhood.

Military aviation has come of age in a hurry, and highly complicated aërodynamic problems incident to new speeds and altitudes cannot be solved by some clever little instruments of the push-button variety. Radar and flight instruments have become exceedingly complex, and this very complexity increases, rather than diminishes, the possibility of error, unreliability, failure, and breakdown.

Time and experience, of course, will work wonders. Improvements will be made. New simplifications will be worked out. But they will apply to yesterday's jet craft. Science meanwhile will have marched steadily and relentlessly forward, discovering new facts, new relations, new forces, new intricacies, and opening up vast and mysterious new vistas.

Jet-aircraft operation and maintenance are only the beginning—combat aircraft must carry armament that can be employed at terrific speeds in the stratosphere with some reasonable assurance of scoring direct hits on enemy air and ground targets in minute fractions of seconds.

Armament Inferiority?

Expert testimony reveals that American aircraft armament is lagging behind the present-day performance of our jet planes. Should we call a halt on plane development until we have solved some of our more baffling armament problems, or should we be content with armament inferiority? The unpleasant fact of the matter is that we are fighting in Korea with aircraft guns that were adapted to the relatively slow-moving planes of World War II vintage.

Furthermore, a great deal of intensive work must still be done in the field of bomb design and in the invention of new mechanisms for supersonic-bomb releases.

The resolution of these typical aircraft and aircraft-armament problems demands military and scientific leadership and ability of the highest order. General Partridge, an air veteran of twenty-eight years' experience, is typical of such leadership.

ON THE WAY *to reply to the Chinese Communists in Korea is a 155-mm. shell from this "Long Tom" gun motor carriage of the U. S. Eighth Army. (Army photo).*

Atomic bomb at Bikini (Navy photo).

Fantastic versus Conventional Weapons

Unusual Arms May Weaken Defense by Making Normal Warfare Seem Useless

Maj. Gen. J. F. C. Fuller

THOUGH a conventional weapon needs no definition, what exactly is a fantastic weapon? It is both a tangible thing and a figment of the mind, because its powers, hypothetical as well as actual, upset conventional military ideas by inducing astonishment or terror.

Disarms the Soldier

Generally appearing irresistible, a fantastic weapon is apt to disarm the soldier by making normal warfare seem to him to be either impossible or ridiculous. In short, it is a devil of of a weapon.

Of such weapons the history of war offers us many examples. Thus at the Siege of Syracuse in 214 B.C., the inventiveness of Archimedes so astonished the Romans that Plutarch wrote:

"All the rest of the Syracusans were no more than the body in the batteries of Archimedes, while he was the informing soul. All other weapons lay idle and unemployed; his were the only offensive and defensive arms of the city . . . At length the Romans were so terrified that, if they saw but a rope or a beam projecting over the walls of Syracuse, they cried out that Archimedes was leveling some machine at them and turned their back in flight."

General Fuller, noted British soldier-author, is one of the outstanding military analysts and historians of the present day. As an officer in World War I he was one of the foremost advocates of tank warfare and did much to mount the armored attacks that proved the value of the bulletproof track-laying vehicle. He is a Companion of the Bath, a Commander of the Order of the British Empire, and a Companion of the Distinguished Service Order.

"Devilish" Weapons

Greek fire, a substance which ignited on contact with water, must, when first used, have appeared a devilish weapon; for if the sea could be set on fire, how was a wooden vessel to survive? Likewise gunpowder, which for generations was anathematized as a "devilish invention," in spite of the fact that during the first century of its use its influence on war was negligible.

Why Cervantes and others, including Shakespeare, considered firearms to be devilish was because they upset military theory and shocked feudal etiquette. They enabled, as we read in "Don Quixote," "a base cowardly hand to take the life of the bravest gentleman . . . A chance bullet, coming nobody knows how or from whence, fired perchance by one that fled affrighted at the very flash of his villainous piece, may in a moment put a period to the vastest designs."

Hopeful Theories

Again, and this time from the opposite mental direction, fantastic weapons seldom fail to beget hopeful theories. Thus Thomas Fuller, in his "Worthies of England," considered that firearms would reduce casualties on the battlefield. More astonishing still, two centuries later, Lecky—another historian—was of the opinion that "gunpowder and military machinery had rendered the triumph of barbarism impossible." Could the first have witnessed World War I, assuredly he would have changed his views, as the second also would have had he lived through World War II.

It is in the second direction that one of the main influences of fantastic weapons is so frequently to be found. For when they appear to be irresistible they give rise to the idea that war can

be restricted or even abolished by international agreement.

Other fantastic weapons and theories readily spring to mind, such as poison gas, first suggested by Lord Dundonald in 1812, and at the close of World War I General Douhet's famous theory, which later on was called "strategic bombing."

An End of War?

According to Douhet's theory, armies and fleets would be abolished by air power which, singlehandedly, could so paralyze and terrorize the enemy's people that, "driven by the instinct of self-preservation they would rise up and demand an end to the war—this before their army and navy had time to mobilize at all."

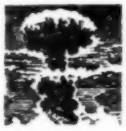
From this it must not, however, be assumed that the fantastic is the monopoly of the novel, whether weapon or theory, for it is every bit as much part and parcel of the conventional. And it is because of this that novel theories so frequently batten upon fantastic, conventional fallacies.

Fantastic Reliance

Thus, during the latter half of the nineteenth century, and even later, the reliance placed on the bayonet in the face of the rifle bullet was fantastic, as also was the idea of a short, mobile war between armies organized as they were in 1914.

Again, in 1939, unsupported as it was by a powerful mechanized army, the Maginot Line was equally fantastic. Yet, had the former existed, the latter would have proved highly effective.

With reference to this last example, the point to note is that normally it is the marriage of the novel with the conventional, and not in the sudden substitution of the latter by the former, in which true military development is to be sought. However, the union must



be not only harmonious but fruitful—it must beget children which inherit qualities of both parents.

Accepting this, then progress in warfare is to be reckoned in terms of evolution. Military revolutions seldom occur and when they do they spring not from a new weapon but from a new or enhanced means of movement.

Thus the introduction of the horse into warfare led to revolutionary results, as also did the invention of the steam and internal-combustion engines.

Therefore, as a prophet, Douhet was on the right track. He had at his mental disposal a new means of movement which carried with it a revolutionary change in the organization of all conventional arms, weapons, and services.

His error was that, instead of following the new track, he halted on it and based his theory of future warfare upon the single idea of spacial heavy artillery which substituted vertical bombardments for conventional horizontal ones. Mentally he was a siege gunner who shifted World War I into the air.

A Warning

His error should be a warning, for today the future of warfare lies halfway between a number of new and evolving means of movement and an ever-increasing number of means of slaughter and destruction.

On the one hand we now have, besides muscular movement, one-dimensional mechanical movement, typified by the railroad; two-dimensional, typified by the tracked vehicle; and three-dimensional, by the airplane and submarine. In addition, science has given us what may be called fourth-dimensional electrical movement because, for all practical purposes, radio, radar, electronic controls, etc., transcend time and space.

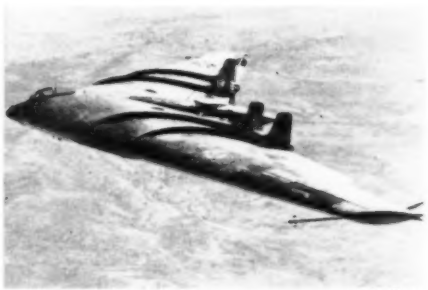
All these are clearly of superlative importance, but what is less clear is the nature of the changes in conventional military organization when these various dimensions of movement are combined.

On the other hand we have startling developments in the means of slaughter and destruction, such as the atomic bomb, radioactive poisons, and guided missiles. And what is astonishing and in itself fantastic about this category of weapons is that many of them are all but unknown to the fighting man.

An Amazing Thing

The amazing thing about present-day warfare is that it is fast passing out of military control. While the fighting man is left with the conventional weapons, the scientist is developing weapons of a novel nature, and out of their rumors the press and the public —including not a few scientists and soldiers—are conjuring forth fantastic Douhetesque theories.

Some time back an article appeared in the *New York Herald Tribune* which illustrates this. In it the writer examined two new weapons, the guided missile called "Matador" and the tactical atomic bomb, which he said could be easily built and cheaply produced. As regards the guided missile, he pointed out that, when fitted with an



Air Force

atomic warhead, not only could "an almost impenetrable defense against enemy planes" be provided but that pinpoint bombing would become a reality.

The tactical A-bomb, he said, when added to supersonic pilotless planes would lead to "fantastic" results. For instance: "A city's *industrial* area could be leveled—with its homes, shopping centers, and offices left virtually unscathed."

Therefore these new weapons held out the promise that the "mass killing of helpless civilians" will become "unnecessary even in the military terms of total war"—rumblings of Douhet, but now humanized.

"Matador" and the tactical atomic bomb were, if I remember rightly, the two "fantastic weapons" announced last fall by President Truman and no doubt were in Senator McMahon's (Chairman of the Joint Congressional Committee on Atomic Energy) mind when, on September 18, 1951, he declared that the time had come to introduce atomic weapons into existing military forces.

Atomic Forces

He said that the U.S. needed an atomic army, an atomic navy, and an atomic air force. Further, that as the U.S. defense budget then stood at the colossal figure of sixty billion dollars, the cost of raising these forces should be met by reducing the cost of conventional armaments by nearly four-fifths. His main point seemed to be: Although, when reckoned in terms of weight, atomic and radioactive weapons are the more costly, when reckoned in terms of destructive power they are the more economical.

The question which arises out of this is not that these things are impossible, for as far as slaughter and destruction go, nothing would seem to be impossible for science. Instead it is, are they the most suitable means of waging war? The answer depends upon what type of war you happen to be faced with.

For instance, when the Emperor Henry IV in 1076 declared Pope Gregory VII deposed and set out with his knights to depose him, what did the Pope do? Having no army, he fell back on the supernatural powers he was credited with: he excommunicated the Emperor and lay his army under interdict. Thereupon, overcome by a spiritual terror, Henry's followers abandoned him, and he himself appeared a penitent before Gregory at Canossa.

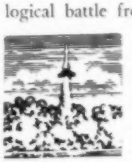
Decisive Error

Henry's error, and it was a decisive one, was that, though fully prepared to fight one type of war, when war came he found himself faced by another type.

But, it may be said, surely this is exactly what the adherents of atomic weapons do not intend to do. They are not preparing to fight, as Henry was, a conventional war, but instead a war which will render conventional warfare ridiculous. This, however, does not dispose of the possibility that there may still be a "Gregory" lurking round the corner, and, as the world is constituted today, a second Canossa would be even more decisive than the first.

Modern warfare is diplomatic, economic, psychological, and, lastly, military. Because it embraces entire nations and therefore disrupts their whole economy, away back in the nineties of the last century a Polish banker, I. S. Bloch, in an immense book on future war pointed out that wars would end in revolutions.

In this he was but following in the footsteps of Engels and Marx, who long before had reached the conclusion that, in certain circumstances, wars could be decided on the economic and psychological battle fronts before a rifle was fired. The circumstances were that in every highly industrialized country there was to be found a vast discontented proletariat—a potential revolutionary army.



Therefore, with different means, war could be fought in two fields—the military and the revolutionary. In the one the leading maxim was Napoleonic—to seek out the enemy's fighting masses and destroy them; in the other it was Marxian—to win over the proletarian masses and by means of them overthrow the enemy's government.

In World War I, Lenin adopted this revolutionary strategy, and, by offering the subjugated non-Russian peoples self-determination and the peasants land, he upheaved the Tsarist régime. Further, during the Russian civil war he learned that the partisan war behind the White Russian front was more effective than his Red Army in defeating Denikin and Kolchak. That is, though organized armies are useful in a civil war they are, nevertheless, at a discount.

Scientific Revolution

Under Stalin, revolutionary war was put on a scientific footing, but, unfortunately for him, in World War II he was faced by an equally revolutionary opponent who had safeguarded his country against Soviet contagion. Hence when the clash came it was on conventional lines, and it reduced Russia almost to ruin.

Nevertheless, immediately the war ended, Stalin launched what to him was the real war—his revolutionary war—and by a fantastic combination of propaganda, subversive action, *coups d'état* and civil and guerrilla war, in five years he established the Soviet Ideological Empire, which to date covers over a quarter of the land surface of the globe and includes about a third of its inhabitants.

He accomplished this partly because his wartime allies had virtually disbanded their fighting forces, but mainly because they had never cultivated the technics of revolutionary war.

What Is the Result?

What can be deduced from this? That if the real war, or shall we say the more potent form of war, is in type revolutionary, conventional weapons cannot overcome revolutionary technics any more than Henry's knights could defeat Pope Gregory's anathemas. In fact, should Mr. Bloch be right, all they can do is to stimulate revolutionary conditions among the peoples of both the victors and the vanquished.

Accepting this to be so, can the fantastic new weapons do any better? They may be able to, should the aim of a belligerent be the complete extermination of his revolutionary en-

emy—that is, the massacre of his entire population and the conversion of his territories into radioactive deserts.

Purpose Conventional

Short of this, and except as a threat to carry it out, they possess no psychological power because, however fantastic their destructive powers may be, they are no more than those of conventional means of slaughter and destruction pushed toward the *n*th degree. Their purpose is, in fact, conventional, and even as terror-raisers this is so.

Does this mean that they are useless? Not at all! All it means is that although they are suited for one type of war they are not suited for another. Here let me give two illustrations of this, the first conventional and the second fantastic:

When the Korean war started, the U.S. forces were highly mechanized and prepared to fight an enemy organized on World War II lines. Nevertheless they soon found that their arms and equipment were not in all respects suited to fight a semiguerrilla army. What was lacking were well-trained, lightly equipped infantry—that is, more primitive fighters—and when these were added to the mechanized forces the tables were rapidly turned.

The second illustration is that of the overthrow of the Kuomintang armies by Mao Tse-tung. When, after the Long March (6,000 miles) in 1935, Mao established himself in Yenan south of the Great Wall, he was no more than the chieftain of a number of ill-armed guerrilla bands. With these he could no more hope to conquer China than he could the United States.

A Peasant War

But either then or later on, appreciating that at bottom the struggle in China was a peasant war, he saw that whoever won over the peasants would be the victor. "The proper attitude toward the peasants," he said, "was that of brotherhood," by which he meant looking upon them as his brothers or allies.

How could he win them over? By promising them what they wanted most—land and rent reduction. These wants he elaborated into his agrarian policy, and when in 1949 he finally set out to defeat the Kuomintang, in two years his ill-equipped armies destroyed Chiang Kai-shek's five and a half million men supported by the resources and wealth of the United States.

In his "Mao Tse-tung" Robert Payne explains this remarkable conquest as follows: Whereas the Kuomintang based its hopes on weapons and dollars, Mao "based his strength upon the thousands of social groups in China, and he saw, very early in his career, that power in the modern world is not waged by guns but by the agreement of the social groups to enforce their demands, *and there is no other ultimate power.*

"It is conceivable," he writes, "that the immense campaign fought in 1949 could have occurred without the use of a single weapon; and indeed, as it was fought out to its inevitable conclusion it became a nonviolent resistance on the part of the Kuomintang, who fled in rout."

"Normally is it the marriage of the novel with the conventional, and not in the sudden substitution of the latter by the former, in which true military development is to be sought."

Three Types of War

What does all this point to? That today we are faced with three main types of war, regular, irregular, and revolutionary. Therefore our problem is: What part will the new atomic weapons play in them?

As regards the first, will they eliminate conventional weapons or will they complement them? Though they will modify their use and render certain existing weapons and tactics obsolete, whatever the dim future may have in store, they cannot supplant them until they are ready to do so.

Because, for the time being, they will have to complement them, which of the three fighting services will they benefit most? The answer is, I think, definitely the air force, because the range of the airplane is likely for a long time yet to remain superior to guided missiles.

Thus carried, the strategic atomic bomb will radically influence amphibious operations by prohibiting large-scale landings and the sailing of closely grouped convoys. Further, radioactive dust will interdict areas, such as landing beaches, defiles, river lines, etc.

Defensive Weapons

In short, atomic weapons will compel an overseas attacker to take to the air, and even then he will risk being poisoned on landing. These weapons are, therefore, strongly defensive.

When we turn to the remaining two types of war—guerrilla and revolutionary—we find a very different relationship. In the second it is obvious that there is no place for atomic weapons other than as terror-raisers, and then only when not used; for though the threat of their use may prevent a potential enemy from going to war, their actual use is likely to stimulate revolution by the chaos they will create.

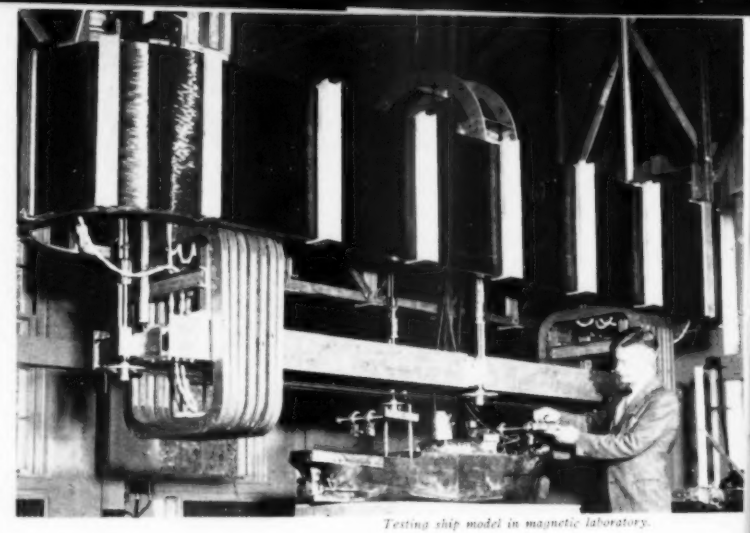
In partisan warfare their use is equally restricted, for the enemy is so dispersed and obscure that to employ atomic weapons against him would be equivalent to hunting mosquitoes with an elephant gun.

In conclusion, I hope I have made it clear that the relationship between fantastic and conventional weapons is but part of a greater problem—the types of wars we are called upon to fight. Could nations, on eighteenth-century lines, confine war to one type only, its solution would be simple.

End of an Era

But since in this age of violent ideologies they cannot, we must be prepared to wage the three types that now face us. Each will require its own instruments and means; therefore in the future there can no longer be as in the past a general-purpose army.

The regular forces must be supplemented by guerrilla and revolutionary forces. And whereas the purpose of the first two is to prevent the outbreak of regular war and to cope with irregular, the purpose of the third is to win the revolutionary war without having to resort to regular. This, as I see the future, is the heart and soul of the war problem.



Testing ship model in magnetic laboratory.

Firepower for Seapower

Naval Ordnance Laboratory Develops And Perfects More Powerful Weapons

Rear Adm. W. G. Schindler

Commander, Naval Ordnance Laboratory, White Oak, Md.

CONTINUANCE of the American way of life is basically dependent on keeping war away from our shores. Recent history shows that the destruction wrought by a war fought within a country is almost as disastrous to a successful defender as it is to a loser. It is the job of the Department of Defense, the Navy Bureau of Ordnance, and the Naval Ordnance Laboratory to keep potential enemies from penetrating our borders.

Phase of Defense

The research, development, and evaluation of ordnance which is the mission of the Naval Ordnance Laboratory (NOL) is one phase of the defense program aimed to prepare the United States for whatever is required in the nature of defensive or offensive warfare to accomplish this goal.

The laboratory had its inception at the Naval Gun Factory in 1929 when naval mine and fuze development were combined to create NOL. Since then, the laboratory has been assigned an increasing list of tasks requiring constant expansion of its facilities. Today NOL, located at White Oak, Md., comprises 130 buildings, employs 3,000 people, and covers 873 acres of rolling wooded countryside 12 miles north of Washington. The total capital investment is $50,000,000.

The greatest asset of NOL, however, lies not in buildings or equipment, but in the staff which carries on the tremendous job of developing ordnance that will be deadly to the enemy yet safe for the men who handle it. Further, the ordnance must be of such a nature that it will deter potential enemies from plans for aggressive war against the territory of the United States.

The Staff

One third of the laboratory staff consists of scientists and engineers, assisted by an equal number of craftsmen and technical assistants. The remainder of the staff includes the employees in administrative, maintenance, and clerical positions.

The NOL projects are specialized ones, including basic and applied research, along with the engineering know-how to make use of the researcher's findings. Many of the most valuable accomplishments of the laboratory are those which are less spectacular than painstaking.

Some of the work has wide industrial use, in addition to its military value. In this class is the contribution made by the NOL radiological laboratories where important advances have been marked in the field of nondestructive testing. Here have been compiled reference studies of welds and castings for the use of X-ray technologists for discovering possible defects in many ordnance items without destroying them.

Fluoroscope Used

Not only in metals has this technique been used. It has recently formed the basis for a fluoroscope to permit the production-line examination of extruded rocket propellants.

Another facility which has played an important part in recent years is the Ordnance Environmental Laboratory. It brings to the laboratory equipment, much of which is unique in design, for testing weapons and ordnance components under simulated service conditions.

Workers Separate

Such tests, and other evaluation analyses, are made by workers entirely separate from the research and developmental staff which has been responsible for creating the weapon so that its testing will be accomplished by persons unfamiliar with its idiosyncracies and unbiased as to its success or failure.

Shocks similar to those experienced on the impact of an air-dropped mine with the surface of the water or by a projectile being fired from a mortar can be simulated and the effect on the weapon noted. The possibility of failure resulting from jolting and jarring in

handling, or in transportation by water, air, rail, truck, or jeep can be determined.

Effects of extreme temperatures and sudden changes in temperature—in fact all the environmental factors to which ordnance may be subjected in any part of the world can be studied under controlled conditions at NOL.

Weapons Tested

Each new weapon is also tested as to its operability. In these days of so-called push-button warfare it is necessary that weapons be as nearly infallible as man can make them. Electronics engineers can adjust a television set after it is in use, but there is no second chance to adjust a mine or depth charge after it is released. Guided missiles, mines, torpedoes, and projectiles must work at the appointed time or they are valueless. No weapon is released to production unless the evaluation staff—apart from the research and development units—has found it workable and usable under service conditions.

These less known sections of the laboratory are often overshadowed by those where the actual creative work is done. Their accomplishments have not been small in the past, nor will they be in the future.

One of the most important programs carried on at the Naval Ordnance Laboratory deals with military and naval fuzes. It was an NOL employee who adapted the British 40-mm. antiaircraft fuze to American manufacture with a minor simplification, but one which saved approximately $230,000,000 during World War II. This fuze is often credited with having downed more airplanes than any other used during the war.

Fuze Developments

It was also NOL which developed all projectile contact fuzes used by the Navy during the war and the first successful designs of the antisubmarine depth charge equipped with proximity fuzes which fire at the point of closest approach. Postwar developments in the fuze program are closely guarded secrets.

Since the war and the acquisition of the famous German wind tunnels, now installed with modifications and improvements at White Oak, extensive work has been done in the field of aëroballistics. The tunnels operate at supersonic and hypersonic speeds. A good share of wind-tunnel time is devoted to research and study in the operation and design of high-speed tunnels for all services.

Recently, in the hypersonic tunnels, air flow at Mach 10, or what amounts to a speed of ten times that of sound under the conditions used, has been achieved.

In the tunnel work, models of missiles, as an example, are mounted in the tunnel and dried air is allowed to rush back through a special nozzle into an evacuated sphere with or without the addition of specially treated air as the conditions require. Air flow is studied through photographs taken by schlieren and interferometer methods, and the forces on the model are measured with electronic balances.

Another recent study in the NOL wind tunnels has used spinning models, operated by an internal motor which can rotate the model in the tunnel at speeds up to 70,000 revolutions a minute. In this way for the first time accurate determinations of the effect of spin can be made at various air and rotation speeds.

This two-million-volt X-ray machine can examine the internal structure of weapons.

A large part of NOL's traditional mission has been in the field of underwater ordnance, and it is here, perhaps, that the biggest contributions to the Navy's ordnance program have been conceived. The underwater ordnance of today is a far cry from that of a decade or so ago.

NOL originated, designed, and tested the airborne mines which destroyed or damaged 2,000,000 tons of Japanese shipping during the last 3 months of World War II. Influence-field principles were also adapted at NOL to the design of torpedo exploders during World War II.

Not only have influence-field principles been used for improvement of underwater ordnance but also in the development of a series of detectors to locate submerged ordnance, particularly on test ranges. These detectors have enabled the Navy to recover more than $60,000,000 worth of torpedoes alone.

Torpedo Proving Range

Acoustic equipment has been utilized in development of a torpedo proving range which provides continuous observation of position, depth, and speed of torpedoes under test.

With a recently completed library of recordings of acoustic surroundings of many ocean areas under varying conditions and at various depths the laboratory is prepared to undertake more detailed studies of acoustic equipment, both for ordnance detection and for ordnance uses. The library includes recordings of ship noises so that in effect the Navy's fleet can be brought into the acoustic laboratories.

Another area of specialized study at the laboratory is that of magnetic fields. Early in World War II, apparatus had been developed for studying the magnetic fields of ships. It was at NOL that the British degaussing designs were improved by incorporation of variable rather than fixed controls to reduce the magnetic fields of ships and render them less liable to damage by magnetic influence mines.

A magnetic ship models laboratory has recently been completed which is

automatic in operation and which will permit the study of scale models of ships and even of small ship parts. In this way the degaussing effect can be obtained during the construction of the ship by determining what its magnetic fields will be. The fields may be reduced by modifying the use of magnetic materials in its construction as well as by other methods.

Alloys Developed

In another part of the laboratory, where magnetic properties are made to order, special alloys have been developed or improved for special uses. One of the most noteworthy of these developments was a specially treated nickel-iron alloy which has made possible successful contact rectifiers and high-performance magnetic amplifiers. This material has been manufactured by at least four different companies under different trade names but using the NOL processing formula and techniques.

Other similar alloys, each with specific and useful properties, have been developed in the Magnetics Materials Laboratory for use in magnetometers.

Other laboratory projects have foreseeable peacetime uses. For example, studies in reënforcement of plastics now under way in the plastics laboratory, where the coating for the Navy's "zipper fleet" was developed, may well be as valuable in peace as in war.

The work carried on at White Oak is supplemented by several field stations. The NOL Experimental Facilities at Hiwassee Dam, N. C., where a large body of deep, calm water has been made available by the TVA, has had an important rôle in full-scale tests of antisubmarine weapons in near-service conditions.

Actuation Tests

The NOL Test Facility at Fort Monroe, Va., due to the large number of ships passing through Hampton Roads has been used to obtain actuation data on various mines, while near-by facilities at Fort Story, located at the entrance to Chesapeake Bay, have been used for rough-water tests.

NOL Test Facility, Solomons, Md., with the near-by air base at Patuxent, has been important in studying full-scale mine air drops. The Explosives Research Department maintains its Explosion Hydrodynamics Division at the Naval Powder Factory, Indian Head, Md.

A factor which has proved of the utmost importance in the success of the ordnance program has been the close coöperation which exists between the staff of the Naval Ordnance Laboratory and the industrial organizations on which the Navy relies for actual production engineering after a piece of ordnance has gone through its initial developmental tests.

"The primary mission of the Naval Ordnance Laboratory is and must remain the supplying of the best possible weapons to make the United States Navy the most deadly in the world for our enemies."

Most of the ordnance developed in the laboratory must be put into large-scale manufacture before it can become an effective part of fleet weapons. The fact that sources of mass production in the country are largely in private industry makes it imperative that the best industrial talent available be brought in to supplement that of laboratory engineers during the transition from development to production. In the last year the laboratory has had contract assistance from over a hundred commercial manufacturers.

Contracts usually take the form of a request for an engineering design plus the production of a limited number of devices for laboratory and field trials. During this period the contractor is usually of great assistance in the preparation of drawings, specifications, instruction manuals, and various technical reports.

The Naval Ordnance Laboratory Advisory Board, made up of managing executives of some of the largest industrial research and development organizations and key personnel from universities, has been important in assisting in formulating management policies. By calling on the know-how and experience of these individuals it has been possible to put into effect some sound policies found effective in older established research and development organizations.

The laboratory management is constantly alert to incorporate features which will attract the caliber of persons needed. The buildings are modern and the equipment is the best available. As an added incentive in attracting progressive personnel, arrangements have been made with the near-by University of Maryland to have classes for graduate credit conducted at the laboratory. At present, over 215 members of the NOL staff are enrolled in one or more of these courses.

Part-Time Positions

Senior members of the staff frequently hold part-time teaching positions at the laboratory or in the near-by universities. A recent innovation has been the establishment of a course of undergraduate vocational training.

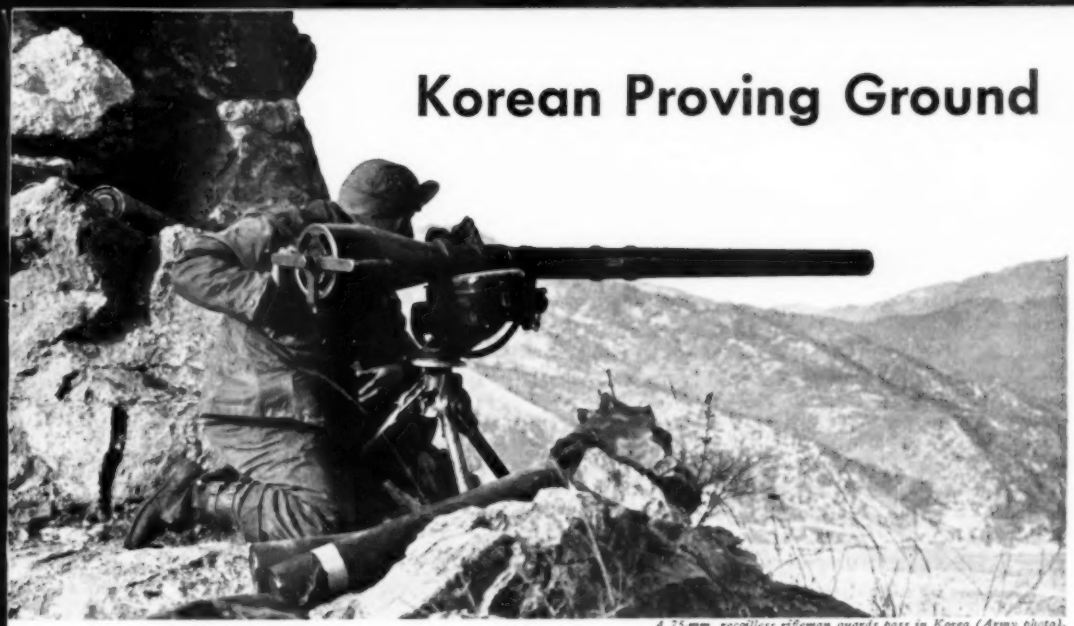
Staff members are encouraged to present papers and take part in scientific meetings. Symposia and conferences are held in the laboratory's well-equipped auditorium in order to give the staff of NOL an opportunity to discuss work and problems with members of other branches of the Defense Department, universities, and industry.

Primary Mission

The primary mission of the Naval Ordnance Laboratory is and must remain the supplying of the best possible weapons to make the United States Navy the most deadly in the world for our enemies and the safest for our men.

It is not enough to keep abreast of potential enemies. They must be outdistanced. This is a matter which has become one of life and death, certainly in Korea and its surrounding air and water. It is a matter in which there can be no letdown until such time when a firm and lasting peace comes to the world. Then, and only then, will the staff at NOL relax its search for the best possible methods for keeping our country safe. Until then the mission is specific and the task incomplete.

Korean Proving Ground



A 75-mm. recoilless rifleman guards pass in Korea (Army photo).

Combat Shows the Need for Light and Mobile Ordnance

Mark S. Watson

OUR operations in Korea have provided only limited opportunity for the testing of certain important new weapons. For in opposition the enemy has been offering no tanks newer than the Russian T34 as targets, no fast armored cars, no massed artillery, almost no airplanes within reach of our antiaircraft artillery, and nothing at sea save two types of mine.

This has meant that, with certain impressive exceptions primarily affecting our own aircraft in operations over enemy territory, there has been little new enemy material to cope with and little tactical experience differing greatly from that of World War II.

All to the Good

As to immediate results, this circumstance was all to the good throughout the summer of 1950, for the North Korean Reds' attack had caught us most grievously unprepared for action and, had it included any new weapons, we would have been in bad shape. We fought with what troops we had and with what weapons we had, then caught up with requirements, and then steadily moved ahead until the U. S. Eighth Army as the prime component of the United Nations' Far East Command became a modern model of battle fitness.

But if one fixes his eyes on long-range results, he is struck by the fact that, ordnancewise, we have developed our high proficiency in Korea less with new material than with our familiar World War II types.

The emphasis in World War II was on firepower, and fortunately we still move forward in that respect with the momentum then gained. But Korean action (calling for concentration rather than volume of fire) has enormously increased attention to lightness of weapons and equipment, this being essential to mobility in the mountains.

Mr. Watson is an internationally known war correspondent and staff member of the Baltimore *Sun*. He is the author of "The War Department. Chief of Staff." and other works, and received the Pulitzer Prize for international correspondence in 1945. In 1947 he was a member of the U. S. Mission to China and Korea.

Lighter Equipment

Now if this was "adversity," it has led to sweet uses from the infantryman's viewpoint. He never objected to lightness of equipment in mountain, or plain either, provided it was effective as well as light. Korea's special impulse toward lightening equipment (added to the pre-Korean trend, as evidenced by recoilless weapons) may prove to be one of the most useful aspects of this long struggle in the Far East. It will be a large factor in speeding up our coming development of new weapons (including the rifle itself) which by their lightness will permit greater mobility without undue sacrifice of firepower.

It is a truism that the fire which counts is the fire that reaches the target. It is a grand compromise which

preserves both the virtues we are trying to reconcile.

Pressure for a new rifle, replacing the semiautomatic Garand with something closer to the lighter, rapid-fire "burp-gun," has been persistent. Much of the public discussion of this very technical issue has been as unreasoning as the talk in favor of an airplane mount which will "fire large-caliber shells at machine-gun frequency." Such a gun will be a little difficult to find.

Light Rifle Needed

But the need for a light rifle capable of rapid fire, yet reliable at moderate range, is unmistakable. Probably the T47 now under development is in the right direction, but its full merit will not be proved for some time, and, when it is proved, the new rifle certainly will not quickly replace the sturdy M1 with which the United States and several allied nations are supplied for years to come.

Yet the lighter weapon, with its shorter cartridge and its other substantial virtues—greater firepower, satisfactory penetration, and 600-yard accuracy—is unmistakably on the way, and Korean experience has been partly responsible.

The new rifle grenade, Energa, now in limited use in Korea, is an unmistakable success; the old M9A1 of World War II will be manufactured no more. In this instance there is lightness only as related to effectiveness, for the new grenade actually weighs 1.4 pounds instead of 1.3, but its reliable range is 100 yards instead of 40, and its explosive charge constitutes 11.6 ounces of the total instead of but 4 ounces, and those are changes of large importance against armor as well as against enemy bunkers.

The Bazooka

The "new" 3.5-inch bazooka hardly needs discussion any more, so complete was its success when it suddenly reached the battlefront at our worst time in 1950. The old 2.36 bazooka, it must be repeated, was an effective weapon when properly used, but certainly the 3.5 allows a wider margin of safety, and its lighter launching equipment (by reason of a reduction of parts) makes it easy to carry—again note the matter of mobility.

This, of course, is the great virtue of the recoilless rifle in the 57-mm. and 75-mm. versions now in wide use, and in the 105-mm. version as well. Here is a magnificent family of weapons for mobile warfare, but it most decidedly is an addition to standard artillery and not a substitute. In stationary warfare the recoilless rifle is of dubious value inasmuch as its great burst of flame gives away the firing party's exact location. When a unit is in a quiet spot it likes to stay there but cannot do so if exposed to heavy counterbattery fire.

Beyond this, the recoilless weapons with high-explosive antitank ammunition are of slight use against earth or concrete, as was proved in the Siegfried Line and now is being proved all over again in Korea. For this purpose the reliance still is on our divisional 105- and 155-mm. guns.

Canister, which dropped out of style when the massed attacks of a century ago were given up, regained popularity in our 1943 fighting with the Japanese and for the obvious reason that massed banzai attacks were much employed by the enemy. The 37-mm. canister shell which had proved its value against charging Japanese infantry was put aside too soon. It would have been useful in 1950, and it did prove useful on revival in 1951.

"We may one day find out that a prime result of Korea's resounding call to arms is the intensive research now under way in the realms of antitank and antiaircraft artillery and ammunition."

Now canister is being developed on a much fuller scale, its return to popularity being comparable to that of the rocket itself. Our new canister will not only appear in several new sizes up to 105-mm. but will take on a new and efficient form. Swift dispersion at 500-foot range should make this new ammunition extremely effective against massed infantry, such as is frequently encountered in the Orient.

The Proximity Fuze

Against massed infantry attack the proximity fuze, too, is still as useful as we ultimately found it in World War II in like employment (as well as against aircraft). It is so effective that its expense is not of critical concern; its tactical value at the moment guides the commander. But if enemy troops are well dug in, it is of no use; the detonator fuze is the need.

Our antitank rifles have not had much practice of late, for the enemy exposes few of his Russian-made T34's any more. It must again be remarked that, properly armed and aimed at the tank's vulnerable parts, the projectiles from the American 76-mm. and even the 57-mm. guns are effective and always have been, but certainly the soldier's preference is for larger-caliber weapons whose gunners need not be quite so deliberate and selective in their aiming.

Targets Lacking

In the main, lack of frequent targets has limited the field experience of our antitank gunners, as it has that of our antiaircraft battalions. In both cases, it is agreeable to note, when normal targets are lacking the field command has converted the AA batteries of twin 40's and quad 50's into double-purpose activity, using them against targets of opportunity with good results for our units' training as well as for the battlefield situation.

On a good many occasions our antitank fire has been directed against enemy tanks immobilized either by injury to their tracks or by the enemy's inability to bring fuel up to them. As the Germans did in like situation late in World War II, the enemy dug these monsters in and used them as well-armored stationary artillery, often very effectively until our own weapons could get the range.

It would be a mistake to think that the enemy is permanently out of tanks—certainly Russia is able to supply a great many more and better ones than the T34 if the situation calls for it. But he is not presently committing any

more of them to an operating theater in which our planes can hammer roads and all that tries to move on them and also the fuel dumps essential to tank movement.

Enemy Holding Back

It is well to keep in mind unfailingly that the enemy has not shown all he has, either in quantity or quality. We have done admirably against what we have met, but, turning again to that long-range view previously mentioned, we might be better off if we had met a little in the way of new enemy weapons. Russia's MIG-15 fighter planes have been welcome, in one sense, as reminders of what one day we may be encountering on other fields, with better fliers in greater numbers.

The enemy's very competent radar-controlled antiaircraft artillery and his efficient 12.7-mm. machine gun have cost us planes and pilots we do not like to lose, but they have also discouraged our habitual trend toward complacency. Our ordnance research is a never-ceasing thing, but we may one day find that a prime result of Korea's resounding call to arms is the intensive research now under way in the realms of antitank and antiaircraft artillery and ammunition.

Our Skysweeper approaches the miraculous; but something even better than the present combination of calculator, weapon, and ammunition certainly lies ahead. Our Munroe-principle antitank ammunition (the "shaped charge"), when first discussed, struck the layman as an undoubted miracle. A great deal of recent development here, too, is yet to be disclosed when battlefield requirements justify.

Improvements Continue

If we find it gratifying that none of our ordnance has been rejected for failure, except as a later design has warranted replacing it, we should find it still more gratifying that the process of improved design goes on. The new body-armor is so light that men are willing to wear it. The new helmet is lighter and better. The World War II half-track is made no more—we use all wheels or all tracks as the situation requires.

A 3.5-inch bazooka team in action somewhere in Korea (Army photo).

One day the new rifle will do better all-around work than the Garand, and even the big, cumbersome BAR, so reliable that the boys like it for all its weight, will one day be phased out as lighter weapons of like effectiveness come into production.

Lighter Alloys

Lightness is a very great virtue, and we are going to see it exploited even more fully as new metals come into use—particularly titanium alloys in which very marked progress is being made by Ordnance research as well as by commercial metallurgists. Experiments already suggest that these alloys can produce an armor which, with forty per cent weight reduction, sacrifices no strength quality. What this means to an airborne army—or to any army, considering all the weapons and equipment which must be manhandled in the field—is something to think about.

New surface treatments with magnesium, to resist corrosion and abrasion and heat injury, are of the most profound interest to the makers of weapons and motors alike. Experimentation in plastics (especially valuable for lightness and noncorrosion) promises to lead toward great benefits for arctic equipment, for fuel lines, and for a host of ordnance applications still under development, such as amphibious vehicles, ammunition and storage boxes, and other items now on the secret list.

For other reasons there is profound interest to the manufacturer, and indirectly to the field forces, in the current research in cold steel extrusion, in which Ordnance has made some immensely valuable contributions. This shell-making process, described in the July-August 1950 issue of ORDNANCE, promises really enormous savings in metals and machining alike, and also better concentricity for the finished shell which, by assuring better flight steadiness, indicates greater precision and range.

These developments appear remote from Korea—certainly nobody wants the Korean action to last until all the suggested improvements come into being—but we can be grateful for the fact that Korea's needs provided much of the general incentive (including the financial provisions) for hastening the armed services' whole research and development program, both basic and applied.

Better Trucks

We are beginning to see very large benefits from the long development work on transport equipment, as noted above. Our vast stocks of trucks of World War II origin served us well but too long for efficiency. Yet there is large benefit in the fact that for years after the war the decreased appropriations forbade prompt purchase of replacements in the old types. Such money as was available went, rather, into development of new types, greatly improved in numerous ways and especially in their degree of standardization.

Vehicle "Families"

We now get the benefit, in new tanks and tactical vehicles, of other types arranged in "families." Much has been made of the fact that the new light tank (the Walker Bulldog) uses parts which also will make up the new medium tank and the ultimate heavy. There is less public awareness that some of the light tank's parts also are

used in an armored personnel carrier, in the tractor which tows the 75-mm. Skysweeper antiaircraft gun, and in three other vehicles which have not yet emerged either from the factory or the security blanket.

Interchangeable Parts

Over sixty major components of the light-tank family are interchangeable, including engines, ignition and suspension systems, torsion bars, and generators. During World War II as many as ten different engines were used in a single variety of tank. Today, in startling contrast, eleven different vehicles use an identical engine.

The various World War II engines had as many as 5,000 parts, mostly noninterchangeable; the new engines have 2,000 parts, of which 60 per cent —and all the high-mortality parts—are interchangeable. This means economy in manufacture, in repair and supply, and in training.

It is a part of that standardizing process which has reduced the Army's automotive spare parts from 700,000 to 125,000. It promises enormous dollar savings, but the field commander is likely to be more interested in the savings he will encounter in time and in manpower. He certainly is interested in the performance of the new 2½-ton 6x6 truck (XM135)—the first to use hydramatic drive, carrying "snorkel" intake and "snorter" exhaust for traversing streams and surf, plus a special kit for arctic use, plus ability to take a 65 per cent slope.

Favorable Comments

It is the man in the field for whom all this is made, and it is gratifying to hear such favorable comment on what we have in Korea as comes from returning field commanders. Comment varies, naturally, with each man's experience, but it is a rare commander who fails to mention, near the top of his list, those lightweight weapons which have permitted the field command a maximum of mobility, whether in attack or in a sustained defensive.

Repeatedly one hears that in mountain fighting the bazookas and the recoilless artillery were all that could be brought up to the point where something was needed in a hurry. The 57-mm. recoilless rifle is the favorite for, light as is the 75 in comparison with its standard wheeled counterpart, an even lighter type would be welcomed by the three men who must carry its several parts over the twisting trails of a mountain country.

Tanks are not of much use there, but the light vehicles carrying twin-40's and the quadruple mounting of

caliber .50 machine guns have been developed into marvelous light support. They are vulnerable to mines to a greater degree than tanks would be, but even when the vehicles are disabled the troops make use of what is left as pillboxes.

Mortar Respected

Among the stationary pieces the 4.2-inch mortar stands high in troop esteem. Training pamphlets found on Red prisoners contain persistent warning about it as one of our most effective weapons. Its arching fire can reach almost any point above ground, and it is extremely effective against enemy concentrations gathered on reverse slopes in preparation for attack. Its white phosphorus shell has spread misery in winter by bursting over the huddled enemy troops and by burning down the few huts in which shivering soldiers have been able for a time to find refuge from the snow and cold.

The 60- and 81-mm. mortars remain effective by reason of their mobility; the latter's light shell (naturally favored because resupply is easier) scatters fragments over a wide area, and its heavy shell penetrates effectively.

How necessary mobility is, as one situation succeeds another, the 2nd Division found out last May during its magnificent defensive in the central part of the Korean front when it bucked twelve separate Chinese divisions off its front and right flank.

A collapse by the Allied unit on its right early in the fighting made it necessary for the division to fall back on that flank in a fighting withdrawal of six days. Then the division slipped to the right to establish a new front; then it moved forward in a 4-day counterattack which drove the enemy back to his original starting point. In all that time no new equipment was provided or asked for—the feats of defense and counterattack were accomplished with the same weapons.

Flamethrower Heavy

The present flame thrower is too heavy for mountain work, just as is the 75-mm. recoilless rifle, in the view of combat veterans, but not much else in the troops' armory encounters criticism. Nor is there undue anxiety over anything the enemy ground forces have been using—with one marked exception. This is the enemy's nonmetallic land mines which have restricted our troop movements more than any other item of enemy equipment. Our present detection devices have failed to counter them, and to this day they constitute just as grave a problem as was pointed out a year and a half ago by Maj. Gen. Clark Ruffner, chief of staff of X Corps during its brilliant amphibious landings.

We, too, have mines which worry the enemy, but it is questionable whether our mine-laying techniques are as good as they should be. For one thing, we have not developed a clear doctrine for the guidance of allies to whom we supply mines, and, as a result, mines have been laid in heterodox patterns which too often result in fatalities to a relieving division.

As to mine-laying techniques in general, we have a good deal to learn from enemy practices, now as in the past.

What Are the Lessons?

What are the lessons of Korea, ordnancewise? For the most part they are the same old familiar ones: We must have on hand (if we can) the exact weapons we need for countering any given enemy, even though we cannot know until a war starts just who the enemy is or where or how or when he will fight. Next, whatever troops we are forced to deploy must know, first of all, how to use those weapons —not one of them but all of them. Next, we must count on the battlefield itself to provide the proving ground for our new weapons while they still are under development.

A-bomb at Bikini (Navy photo).

The Rôle of Atomic Armament

Weapons Are Not Supplanted—They Are Supplemented

T. Keith Glennan

IN this day of mechanized warfare, electronic warfare, aërial warfare, submarine warfare, atomic warfare, and of planning for what some one has called "push-button" warfare, it is well to keep in mind that the most used weapon of World War II was also the most used weapon of World War I, the Spanish-American War, the American Civil War, the Texas and United States wars with Mexico, the Napoleonic wars, and the American Revolution.

The Basic Weapon

That weapon is the rifle or musket. In the hands of resourceful, well-trained men, this has been the basic weapon of all wars for the past two centuries.

In pointing this out I do not mean to underestimate the importance of the new weapons, atomic or otherwise. I simply want to call attention to the fact that, for the most part, weapons are not supplanted—they are supplemented. New weapons come and find their place in the modern military force, but the basic older weapons tend to stay on.

There is a continuous reshaping and reforming of the military force to accommodate and use new weapons. There is also a continuous development of methods for the use of new weapons—the strategy and tactics made possible by their greater firepower.

The slingshot is gone, but only because we have put into the hands of the individual soldier slingshots which propel missiles by chemicals instead of thongs. The job the slingshot was designed to do still has to be done. There must always be a weapon, easy to carry, maintain, and use, in the hands of the individual soldier. That's why even an "atomic" army will still have rifles.

Dr. Glennan is a member of the United States Atomic Energy Commission. He is now on leave as president of the Case Institute of Technology, Cleveland, Ohio.

Sea Warfare

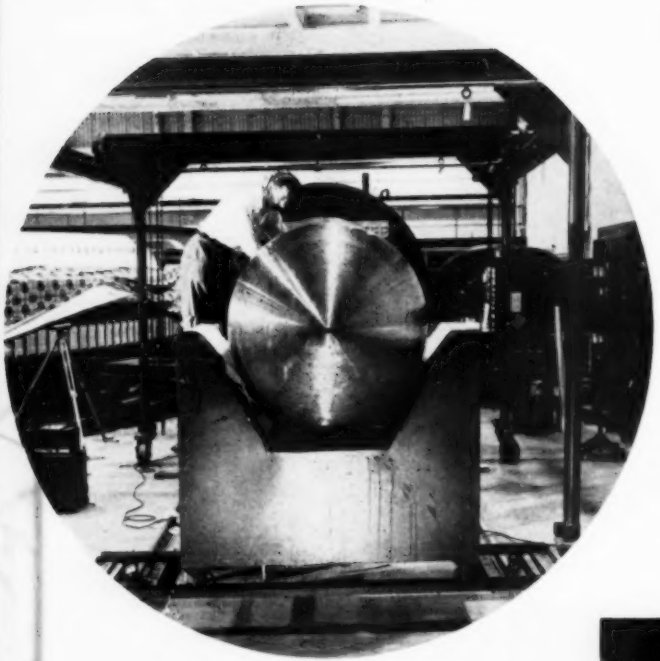
In naval warfare sailors used to lash their ships together and fight it out with knives, fists, swords, and other weapons of direct contact. Then came a time when sea fighters threw iron "rocks" at each other from point-blank ranges. With the development of steel ships and high explosives, they learned to stay out of sight of each other and throw things—much bigger things—with terrific explosive power.

In the last war the antagonists threw things so big and from so far away that a man had to go along with the explosive missiles. This man piloted a

(Continued on p. 928)

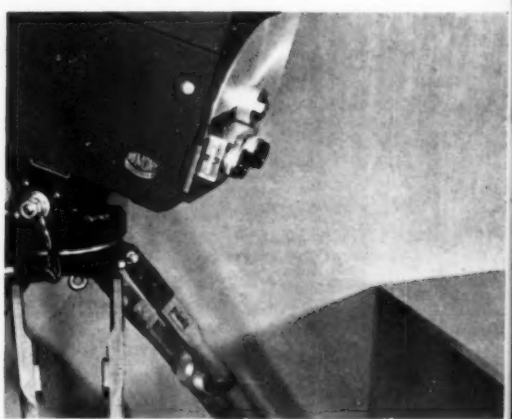
FROM ATOMS

The development and control of atomic energy is vital to the security of America. Daily, in laboratories scattered over the Nation, scientists are working toward further development and greater control. However, not all the research concerns wartime purposes. Experiments are constantly conducted seeking new ways to utilize our knowledge of atomic energy for industrial, medical, and other peacetime purposes.



Above, the Brookhaven Laboratory's 3.5 million electron volt generator; below, technicians at Brookhaven lower a sample intended for irradiation into a 1½-ton lead shield.

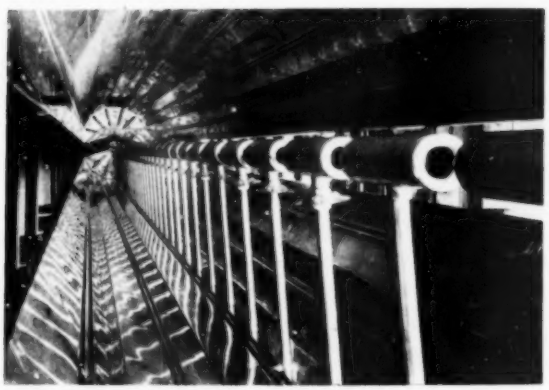
A technician at Los Alamos peers into the 42-inch cyclotron.



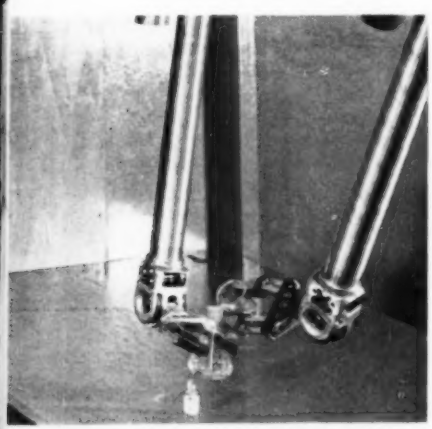
Radioactive materials handled by remote control are viewed by
Right, a scientist at Argonne prepares to harvest the radioactive

TO USEFUL ENERGY

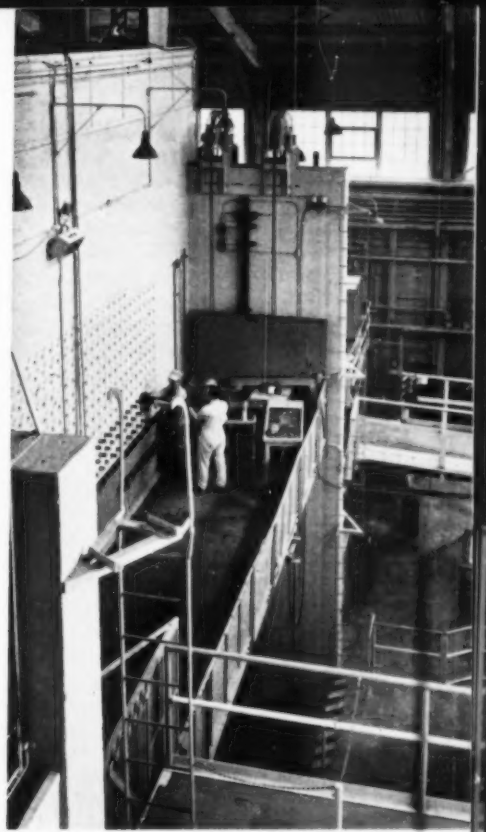
Technician standing behind liquid-filled barrier uses "mechanical hands" to conduct experiment with extremely radioactive material. (USAEC photo).



Linear accelerator at the Radiation Laboratory, University of California.



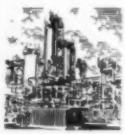
stereo-television at Argonne Laboratory, above.
dextran produced by fermentation in flasks.



Technicians at Oak Ridge remove plugs from some of the 1,248 fuel channel openings in the graphite reactor.

vehicle which carried the missile to a point near the target, then let it go by itself. This intermediate carrier of a projectile is otherwise known as the bombardment airplane. Nowadays, of course, we're working on hurling a chunk of explosives over long distances without sending the man with it. Such missiles, we say, are guided missiles.

There is, however, one great difference between old and modern weapons probably more far-reaching than all others—a difference that is of major concern to the men and organizations comprising the American Ordnance Association.



I am speaking of what I believe is the single most significant development in warfare in the past half century—the tremendous demand which modern war places on the resources of nations which must be prepared to defend themselves by the use of all the known tools and by the development of new ones.

A Close Look

I want to discuss this matter from several aspects. In fact, all of us should "walk around it" several times, taking a close look from every standpoint, because it is of the utmost importance to the economic and social health of the United States during the period which started about three years ago and which will end only when there is an end to the senseless struggle patterned by the leaders of the largest national masses of people on the earth today.

I am convinced that we can confine the hot war and keep other areas cool only if we are fully prepared for a full-scale hot war. Our main difficulty lies in the fact that we must remain prepared for a hot war anywhere in the world for a period of from two to twenty years. But we must do it in such a way that we will have greater, not less, resources twenty years hence than we have now.

And while we must be prepared to defend ourselves in a full-scale war on all fronts, we must also be prepared to stem incipient local hot wars at every point at which the enemy may find it befitting his pattern to fan the embers of cold war into killing flames.

One of the major items in the big list of matériel which we must provide for our all-out defense is atomic energy. There are several ways we can use it. The first use which comes to mind is as an explosive of greater destructive power than anything ever known and with the possibility, however remote, that this power may be increased a hundredfold.

Secondly, we will develop its use as a source of energy for the engines which will drive the vehicles of war through the spaces of the sea and, we hope, through the spaces of the air.

Indirect Benefits

These are the direct uses of atomic energy in war. Immeasurable indirect benefits will stem from our expanded knowledge of the materials of war and the extension of our ability to care for human lives. Also in this area of what we now call the indirect benefits, and in a partnership of all the sciences, we may find the most important and electrifying weapon of all history—a war-stopping weapon instead of a war-waging weapon—the weapon of food in plenty for all the peoples of the world.

The current national-defense effort must be designed for three purposes. We must prepare to defend ourselves in all-out war. We must have the forces to put down local wars—that is, to carry out policing actions. Thirdly, we must prepare to wage peace and to wage it in a manner which will inform all the peoples of the world that there is no peace without freedom. This is one of the principal reasons why we must maintain a real program to develop the constructive uses of the atom.

Resources Taxed

Atomic energy is also the new development which most clearly demonstrates the demand of modern war on the total resources of a nation. As a matter of fact, the very development of atomic energy for military purposes was possible only because we had the scientific and industrial resources to carry out precision production operations on a big scale.

Such resources are not limitless, however, and while the national atomic-energy program now has a terrific momentum and is gaining ground every day, new organizations and units which come into the program as it expands must dig and scrape to get together the technical and production teams to do the jobs.

Complex Problem

When we recruit a company now to take on a new task in the atomic-energy business, the management is confronted with more than a conversion problem. When one of the big petroleum or chemical companies, for example, takes on an atomic-energy job, it is not like converting from automobiles to tanks.

The technology is new, the skills and techniques are new, the tools and equipment are new, the materials of production are new, the tolerances and specifications are unheard of in many fields, and there are new hazards.

This is not to imply that experience doesn't count. It is quite clear to the Atomic Energy Commission and to many of our contractors, for example, that the chemical processing companies are well equipped to take on many of the fissionable-material production jobs. And it is not by accident that one of the Nation's largest manufacturers of protective paints has been selected to operate a new AEC plant for processing feed materials for a fissionable-materials production plant.

The extent to which the industrial community of America is involved in the atomic-energy business is well illustrated by a bit of incidental research done on the index to advertisers in ORDNANCE.

In one recent issue of this magazine, 132 advertisers were listed. Thirty of them, located in 23 cities spread over 17 States, were prime contractors of the Atomic Energy Commission or held subcontracts for more than $25,000 worth of work.

These included the big names in chemicals, nonferrous metals, foundry work, aircraft, food processing and packaging, powder manufacturing, coke processing, machine tools, photographic film, tractors and trailers, etc.

The plant at Oak Ridge for producing uranium 235 by the electromagnetic method.

The spread of just this small segment of the more than 500 contractors doing work for the Commission is an indication not only of the scope of the national atomic-energy program but of its complexity.

Widespread Operations

The operations of the national atomic-energy enterprise extend from the ore fields of the Belgian Congo to the proving ground on the other side of the world at Eniwetok. Between these two points, a travelogue would cover the full production program from the digging of uranium-bearing ores through the preparation of feed materials, the manufacture of nuclear explosives, the development, manufacture, and testing of atomic weapons.

There are more than 100,000 people employed in the program today, with more than 50,000 of them engaged in the construction of new facilities. Another 45,000 are employed in operating the production chain and the research establishments. These are employees of contractors, not the Government.

The Commission itself employs on Government rolls something over 6,000 people in the management of the program, security operations, and in the normal administrative and fiscal functions required under governmental sponsorship of such an enterprise.

Huge Land Area

The total land area occupied by the research and manufacturing and testing facilities of the Atomic Energy Commission amounts to some 2,800 square miles, an area almost equal to the States of Rhode Island and Delaware combined. The capital investment in plant and equipment is now about $2.5 billion and is actually in process of being doubled.

In ten packed years since work started in earnest on the development of atomic energy for military purposes, the atomic-energy program of the United States has tapped, on a continuing basis, the reservoirs of scientific, technological, and managerial strength of America. I do not see any diminution of our demands in the years ahead.

One way we tap these reservoirs is through the contract-operations policy of the Atomic Energy Commission. This policy is basically a technique of hiring organizations instead of individuals. Of the nearly one hundred cost-type contractors, including all the operators of Government-owned facilities, about twenty per cent are educational institutions, and nearly as many are chemical and minerals engineering firms. Fifteen per cent are engineering and technical service firms, and about twelve per cent are general-service organizations supplying us with transportation, maintenance service, etc.

Construction companies account for nearly 10 per cent; industrial research organizations 8 per cent; electrical equipment manufacturers 5 per cent; and private research institutions about 5 per cent.

A helpful index for the readers of ORDNANCE to the scope and momentum of the national atomic-energy program is the actual rate of expenditure of funds for all purposes, including the current expansion program which itself is larger than the total wartime building program.

Our expenditures are at a rate in excess of a billion dollars a year. Based on a comparison of budgeted funds, the atomic-energy program under AEC direction is now about four per cent of the current total defense cost.

Materials for Weapons

While a substantial amount of the total atomic-energy expenditure goes into research and development in fields not directly applicable to the military defense of the country—even though we see an eventual and necessary contribution to the total war strength of the Nation—by far the greater proportion of the Commission's funds goes into the production of fissionable materials for weapons and the development and manufacture of atomic weapons themselves.

This amount can hardly be considered the total cost of atomic armament, however, since all the armed services are investing heavily in the training of men to use atomic weapons, in the building of the special organizational elements required for atomic war, and in developing and manufacturing the vehicles to deliver atomic weapons.

I believe it is safe to say that the military planners have not made—and show no signs of making—the same mistakes which have been made in the past with respect to new weapons and new techniques of war. There is no group of "die-hards" to provide the setting for another Billy Mitchell episode.

No "Old Guard"

I don't even believe there is any unimaginative "old guard" which might fail to see ahead, as there may have been in the past in connection with such things as the application of electronics for military purposes or the development of tanks, tank destroyers, self-propelled guns, or aircraft.

In general, atomic energy is one method and weapon of war which will find its place in the total structure of

our armaments much more rapidly than any other development of modern warfare.

The extent to which our total armed strength is converted to a pattern of dominant dependence on and employment of atomics and the speed with which this might be done are conditioned by two factors.

Rate of Development

The first is the rate of scientific development and accomplishment of the technological and ordnance phases—through engineering, manufacture, supply, and maintenance—in the field of both weapons and power systems. The second is the precise determination of the type of action which our military forces may be called on to carry out during the next decade.

There are major changes in the military structure taking place in order to accommodate atomic energy. But these changes cannot be made faster than the actual provision of the new weapon in fully employable quantities and qualities, nor can such changes be made in a manner which will in any way reduce, during changeover, the effectiveness of the armed forces for any type of action they may be called upon to carry out.

Most of the armchair analyses and predictions of things atomic in the defense of the country reflect a lack of understanding of the time-consuming problems of research, development, experimentation, engineering, production design, manufacture, and delivery.

Weapons Improve

As far as the direction of atomic weapons development is concerned, the unofficial prophets would find it hard to go wrong. The quite obvious direction of development of any new item of ordnance is to improve it as a weapon both quantitatively and qualitatively.

This means you want to increase its effectiveness; you want to increase its flexibility in order to use it under a wide range of war conditions. In other words, you want a wide range of sizes. You also want to make it easier to handle and maintain; you want to make it easier to manufacture, to simplify it for the using arm, and do everything else you can to make it a better piece of ordnance and insure its availability and deliverability when needed.

In the field of atomic ordnance, this means both bigger weapons and smaller weapons. It means we want weapons deliverable in many ways—by guided missiles, shipborne aircraft, ground-support aircraft, long-range bomber aircraft, ground-fired projectiles for short ranges (popularly known as atomic artillery), underwater vehicles, etc.

In short, if there is any type of employment of explosive force in warfare in which nuclear explosives can do a better job than chemical explosives, then we want to know that fact, and we want the nuclear explosive packaged to do the job.

"Most of the armchair analyses and predictions of things atomic in the defense of the country reflect a lack of understanding of the time-consuming problems of research, development, experimentation, engineering, production design, manufacture, and delivery."

The effort to learn all these things is a multipronged one. It is costly. It employs the knowledge of both the scientist and the soldier. It requires the techniques of the engineer and all the skills of management and labor in the closest kind of coöperation. And it takes time.

There is no better evidence of the constantly accelerating program toward the end of maximum application of

atomic energy to military purposes than the fact that the year 1951 saw more nuclear detonations than the total of all known nuclear detonations in the six preceding years.

Such a rate of developmental experimentation probably won't be maintained, but one thing is certain: If atomic weapons are to be a principal source of power in the arsenal of democracy, they must be proof-tested continuously.

But what one must keep in mind as the successive tests go by is that the conduct of a nuclear explosive experiment at the proving ground is a small part, timewise, of the total job being done. Any given job of weapon development starts with the establishment of a requirement, leads through the idea stage of how to make it work, then to the mechanics and development of components, and finally to the custom-building of a test model.

More Than Dollars

After the proof test come engineering for production and development of the handling and delivery systems. That is why atomic defense is a function of something more than dollars.

Thus far I have discussed only one of the two major factors conditioning our change-over to total, or near-total, atomic defense forces. The second has to do with the possible or probable employment—or readiness for employment—of our armed forces in a world situation in which little wars are apt to break out if the free nations are not prepared to stop them and in which local wars are apt to grow into world wars if not kept local.

Here again the military planner must keep in mind the fact that the neighborhood patrolman on the lookout for prowlers or "second-story men" has little use for a tank.

A cold-war military force similarly may have many jobs calling exclusively for traditional weapons.

A Better Perspective

This brings me back to my starting point of the infantryman and his rifle. If I have made a complete circle around the business of using atomic energy as an explosive weapon in war, I hope "walking around" this problem will provide a better perspective on the broader problem of designing and maintaining a military force adequate for whatever defense action is required.

At the same time full consideration must be given to the long-range factors of sustaining and continuously expanding a political-social-economic structure able to support the military force and able to insure freedom for ourselves through support, leadership, and assistance to the other freedom-loving peoples of the world.

Army photo.

Our Tanks in Korea

Ordnance Field Service Is the Key to Armored Victory

Lieut. Col. George B. Pickett, Jr.

"And Joshua drove out the inhabitants of the mountains but he could not drive out the inhabitants of the valleys for they had chariots of iron."

THOUSANDS of years have passed since Joshua was defeated by the charioteers, but the truth of the Biblical quotation has once again been proved in Korea. Early in that conflict the North Koreans drove down the South Korean valleys with their T34/85 "iron chariots," and all fled before them until they were stopped by our better and more numerous "iron chariots" of the M4A3E8, M26, and M46 types.

Dominated Valleys

Our "charioteers" then raced up the valleys almost to the Yalu, and, although they subsequently withdrew south with their comrades, they have dominated the valleys continuously, and they have also enabled our infantry to dominate the mountains.

But the successes of our armor were

not obtained without overcoming numerous obstacles. Our tanks in Korea have operated against the enemy in the face of every known obstacle of terrain, adverse weather condition, inadequate logistical support, parts shortages, and lack of prior training.

Yet the record shows that no real success in Korea was achieved unless our tanks were able to participate. In many situations they were the difference between victory and defeat, and some of the tank actions in Korea have assumed epic proportions.

These successes could have been expanded into large-scale victories if forces of combat-command and armored-division size had been available.

Colonel Pickett is an officer with our Armored Forces in the Far East.

Much To Learn

Many articles and critiques have been published on the tactical aspects of armored operations in Korea, but there also is much to learn from the logistical problems faced by the original armored units which fought there during 1950 and early 1951—the shoestring phase of the war. Their problems included insufficient logistical support, inadequate recovery and evacuation means, lack of spare parts, untrained maintenance personnel, old and worn-out equipment, and previously undiscovered "bugs" in new equipment.

The tank units that first arrived in Korea had been hastily built up to strength with men from all branches of service. Experienced tankers were in the minority, and inexperienced crews mean poor maintenance. Also, the units were few in number. Needless to say, the terrific demands of continuous combat with limited time for maintenance imposed a real burden on the tankers.

Army photo.

A twin 40-mm. gun carriage and an M4 tank blast away at the enemy in Korea.

Tanks Immobilized

For example, one tank battalion on October 2, 1950, had twenty-six M26's of which only six were operational; the rest were deadlined for maintenance failures. There were many contributing factors in addition to lack of adequate time for maintenance, such as inexperienced personnel and rugged terrain that taxed vehicles to the utmost.

In addition, battlefield recovery in Southwest Korea—the IX Corps zone—was a tremendous problem. A retriever unit was available but could not be employed without blocking the only road in each division zone which could be used as a main supply road.

Another real problem in battlefield recovery was the inadvisability of leaving crews with disabled tanks along the axis of advance. During the period September 18-October 5, 1950, the speed of advance of the tank units was such that, in a few minutes, the crew of a disabled tank would be alone in enemy-infested territory, for a Patton-type, "roads and shoulders cleared of mines and enemy" advance was being made. The surrounding hills were still full of enemy soldiers, making it foolhardy to leave three to five men alone in a broken-down vehicle.

Support Poor

There is no implication intended or effort made to place blame on any group, but back-up support for tanks during the first five or six months of the Korean "police action" was poor. Ordnance heavy automotive maintenance companies were rushed to Korea with excellent backgrounds in morality lectures, I and E, TIP, intramural athletics—and precious little experience in how to support tanks.

The IX Corps Ordnance Officer, Lieut. Col. J. E. Harbert, was one of the first to recognize this deficiency and to take positive action to improve the quality of the Ordnance field-service support. During this period, spare parts were lacking and maintenance personnel were only partially trained or were unfamiliar with their jobs. In addition, the field-service support for tanks was based on the "Type Field Army" system.

A situation existed in November 1950 wherein the armored units had tanks designed by some of the best brains in the automotive industry along with officer personnel holding some of the highest technical degrees from leading universities—and poor back-up support. The best designed tank in the world is not capable of sustained action without adequate support in the field.

Threefold Problem

The problem facing the IX Corps Ordnance Officer early in November 1950 was threefold: first, to get the parts; secondly, to see that the supporting (nondivisional) Ordnance troops were properly trained; and, thirdly, to readjust the organization of the support from the "Type Field Army" system to a system that fit requirements.

The parts situation was not solved overnight, but direct action was taken

to obtain lateral as well as vertical supply, and some parts materialized. To coordinate the effort, Ordnance units were visited by the entire corps Ordnance staff, and the corps Ordnance Officer was in the field continually to make the field service work.

But shortages of recovery equipment caused great concern. Naturally, there was no additional recovery equipment available at the time. To obtain an adequate maintenance, battlefield-recovery, and evacuation plan for the great United Nations' offensive of November 24, 1950, the IX Corps Armor and Ordnance Officers analyzed the experiences of the armored units of IX Corps in Korea and developed a system based on local conditions.

The system developed for the operation consisted of pooling the available evacuation and recovery means in each division under centralized control and having this centralized agency, termed the "Division Maintenance Control Agency (DMCA)," coördinate the use of all recovery equipment along predesignated axes of advance.

The maximum use of mobile maintenance teams for "on-the-spot repairs" along these axes of maintenance was stressed. The activities of the maintenance and recovery teams were to be coördinated directly by the DMCA, using both radio and telephone communication. It was planned that a "maintenance and recovery" operation and situation map would be maintained by the DMCA to give a current picture of the location of the recovery and repair teams and to show which teams were available for assignment to new tasks.

Difficulties

Naturally, there were difficulties encountered, principally due to lack of radio communication and to the shortage of time to indoctrinate the users in the new system. Furthermore, the UN offensive became a UN withdrawal before the plan was completely field-tested, but initial advantages of the system indicated its desirability when there are definite shortages of recovery equipment.

It was also determined that the DMCA technique is equally as effective in defensive actions and retrograde movements as in offensive combat. The division Ordnance Officer is the appropriate officer to operate the DMCA in our infantry division as presently organized.

Obvious Lesson

The obvious lesson from the difficulties of field-service support during this period is the need for developing experienced field-service officers along with the designers and technicians.

The field-service phase, in the final analysis, is the end product of the Ordnance Corps mission—getting the equipment to the user when he needs it and doing the Ordnance share of keeping it operating without gaps in the service. The IX Corps was fortunate, indeed, to have as Ordnance Officer a "fire-eater" with wide experience in field service.

The type of field service that we desire can best be illustrated by the incident at Chasan, North Korea, on November 28, 1950. The U. S. 2nd Infantry Division was fighting out of the trap south of Kunu-Ri. One platoon of Company C, 72nd Tank Battalion, had fought its way through the pass enroute for attachment to the 27th British Commonwealth Brigade and had arrived at Chasan with two battle-damaged M26's. It was almost dark, the weather was subzero, and confusion was rampant on the road south of Sunchon.

An Army Ordnance company was withdrawing from Sunchon to Pyongyang. An assistant corps Ordnance Officer pulled the track section of this withdrawing 2nd Division. That is an and repaired the damaged tanks in time for them to move out at 0400 with a British battalion to assist the withdrawing 2nd Division. This is an example of timely and adequate Ordnance field-service support.

Armored Vehicles

Another subject about which there has been much discussion concerns the relative merits of UN and enemy armored vehicles and also comparisons of the desirability of our own models. There were numerous arguments in Korea between admirers of the M46 and M4A3E8 as to which was the better tank—but there were no supporters for the M26.

Advocates of the M46 pointed out its small turning radius, more powerful gun, and additional protection when compared with the M4A3E8. The M4A3E8 advocates pointed out the additional weight and width of the M46 and the problems of maneuvering it in Korea.

An analysis of these opinions would indicate that the most desirable tank for Korea—and in my opinion *the* desirable medium tank—would have the automotive features of the M46, a powerful gun as on the M46, better armor protection by using sloped and compound obliquity as on the JS III, and weight and over-all dimensions in the M4A3E8 class. It can be designed.

Important Factors

Width, length, height, and weight were definite factors to be considered when using tanks in Korea. During several tank operations by IX Corps the width of the tank determined the tactical plan for tank participation.

For example, in one limited objective attack between Hwachon and Kumsong in August 1951 the critical terrain feature limiting tank employment was a mountain pass with only ten feet clearance between its rock walls.

The tank participation was arranged by having the tank company of the 5th Infantry (M4's) rush through the pass and go into position beyond it on the Kumsong side. The division engineers then blasted the rock walls sufficiently to enable M46's of the 6th Tank Battalion to pass through the defile.

Loading a tank with 90-mm. ammunition.

Previously, in February 1951, tank support for an attack of 27th BCB was planned east of Chipyong-ni by substituting M4's for the more readily available M46's because the route of approach for tanks to the objective was a 10-foot road with steep sloping banks on either side.

Merits Examined

The relative merits of our own tanks and the Russian T34/85 deserve examination. At times we have been led to believe that the T34/85 was the world's finest medium tank; yet our M4A3E8 was able to fight it on equal terms. Naturally, the T34 is no match for the M46.

However, there are certain features on the T34 that are very desirable. For example, the simple design of the track and the ease and speed with which damaged tracks can be replaced is one of its outstanding features. Our designers could well profit by studying that track. After driving a captured T34 around Taejon in October 1951, several of us were amazed at its towing power and horsepower-per-ton ratio. However, the inside of the tank is designed for midgets.

Our driver, a man about 5 feet, 8 inches, in height, could scarcely fit into the driver's compartment and had to lean backward in order not to bump his head on the frontal armor of the tank.

Many Lessons Learned

Many tactical lessons have been learned in Korea. Almost every officer in the combat arms considers himself a brilliant tactician. However, Korea showed conclusively that no matter how brilliant the tacticians, an army can operate successfully only if properly supported by a well-organized and flexible Ordnance field service.

We reportedly have the greatest industrial know-how in the world; but if we are to win battles we must put the end product of that know-how on the battlefield and sustain it there to the best of our ability.

Air view of a typical ammunition loading and assembly line.

Explosive Ammunition Production

A Balanced Tool Reserve Is Vital to Future Preparedness

Brig. Gen. Merle H. Davis

MOST Ordnance items are non-commercial in design. The user—the fighting man—has needs that can be met only by matériel which is special and which cannot be bought from vendors' shelves. The ordnance commodity furthest removed from commercial counterpart is explosive ammunition. Even the production thinking that controls the *approach* to the procurement of ammunition has its peculiarities. The things that set ammunition apart, even in the classification accorded it in the Army's logistic system, deserve a brief scrutiny.

Huge Tonnage

In the first place, ammunition is the great tonnage commodity of war. The ammunition of all types produced by the two Ordnance services in World War II would have filled the cars of a solid freight train reaching from Boston to Los Angeles.

A scarce raw material or an inefficient fabricating process can have no place in output such as this. The metal components and the propellants and explosives must feed into the loading and assembly plants in an uninterrupted stream. It has become a basic premise in ammunition thinking that no one important component *can be allowed to have production difficulties that are disproportionate to all the others.*

Failure Costly

Another factor which any one connected with ammunition production must always have uppermost in his mind is the high cost of failure in the hands of the user. Compared with a mechanical failure in a tank or a gun, the malfunction of a complete round in firing does not normally result in a credit memorandum and replacement by a vendor. The damage is done. To the uninitiated, most of the evidence as to the cause has apparently disappeared. Sometimes even people with long experience have difficulty in tracing the cause either to a design deficiency or an error in fabrication.

General Davis, a recognized authority on his subject, is Chief of the Ammunition Branch, Industrial Division of Army Ordnance. This article is an abstract from several recent lectures given before engineering societies and service schools.

Two Results

The high cost of failure in use has led the two Ordnance services into: (1) a rather expensive surveillance organization and procedure to guard against the effects of deterioration of ammunition in storage; and (2) a special insistence on getting the available facts about every serious malfunction in the field.

During World War II, the Army Chief of Ordnance, because of the zeal of Ordnance personnel with troops and the coöperation of the troops themselves, is believed to have gotten important information on ninety-five per cent of the serious malfunctions that occurred in actual combat. The

storehouse of accumulated knowledge about mistakes of the past is indeed the most valuable asset in ammunition production today.

Both the designer and the producer of ammunition have two goals always before them: (1) to produce continually improved types that are more effective and more efficient than what have gone before; and (2) to be certain that those types are capable of mass output with the minimum expenditure of time, manpower, and materials. These factors, which more often than not are in conflict, must always be weighed against each other.

Ammunition Production

So much for the background. The actual production of a round of ammunition, whether it is intended to be fired from a gun or launcher, thrown by hand, buried in the ground, or dropped from a plane, can be divided into three parts: (1) the production of the metal components or other inert parts, (2) the production of the required explosive materials, and (3) the loading and assembly operations which combine the diverse components and materials into a complete round.

The loading and the explosives production are just as important as making the metal parts, but they certainly give less trouble today. In 1940, before there was an array of Government plants in being, those two facets of the job were the major cause for concern. Many of these plants have been rehabilitated and are in production. All but one of the reactivated plants has a contractor-operator who runs the lines for a fixed fee. One is still operated with Government employees, as is the reactivated ammunition proving ground. The contractors for each plant were selected before 1950. Almost all of them are World War II production veterans. Most are operating the same plants as they did during the war.

There is much residual experience available, both in the contractor organizations and in the communities surrounding the plants—an asset of no small value. Before the war in Korea, each assigned operator had made, for a fee of $12,000 or less, and submitted to the Chief of Army Ordnance, a study outlining his plan for operation in case of reactivation. Such plans exist for the plants still not reactivated.

Government Function

The loading and assembly of explosive ammunition in this country has become a function of government. Except for some residual know-how in the experienced contractors, knowledge of the operations exists only in the Ordnance services. This does not mean that Ordnance gets no outside help in the improvement of techniques.

Since the first of the modern loading plants was opened in 1941, the order of the day has been more and more mechanization of the operations—a trend which continues. The most important result is not the increased output nor the reduction in the number of employees on a loading line; the most important dividend is a better and more uniform product, with a reduction in the errors that can be made by human beings.

Major Problem

The major problem in the reactivation of the propellant and high-explosives works has been in their rehabilitation. Taking a loading plant out of mothballs is rapid and comparatively inexpensive; not so for a huge chemical works. However, once rehabilitated, there is a fine chemical industry available for efficient operation.

Army Ordnance has the assigned responsibility for furnishing the bulk powder and explosives for all Department of Defense needs. If there is a trend today in this part of ammunition production it is that Government is getting out of the business of providing the supporting chemical materials. The three anhydrous ammonia plants still Government-owned are now all under lease; we buy the ammonia we need.

It is a good principle to restrict the operations in the Government plants to those things which cannot be obtained from private enterprise or which cannot be obtained in needed quantity to meet the time schedule. However, Ordnance must watch closely the trends in the availability of supplies that have been purchased traditionally from private plants.

An example is the disappearing black-powder industry where commercial demands are steadily drying up. From one plant that closed its doors two years ago Ordnance purchased for a modest sum the equipment that could be moved. That equipment is in storage at a Government plant against the day when its installation is demanded to meet continuing needs for that ancient explosive material.

Industry Shrinking

Another example is a shrinking pyrotechnics industry. Formerly that industry did all the loading of illuminating shell, flares, and similar items. Re-

The hydraulic presses for a steel cartridge case plant, below, were installed while the building was under construction and stand like sentries in their protective coverings.

cently the Ammunition Center has been forced to adapt a line in a Government plant for such items; the industry can no longer meet the current needs without an unjustified expansion.

Planned Years Ago

The production-control procedures and methods of regulation of the flow of components and materials into the loading plants were planned twenty years ago with one of the automobile companies that had a somewhat similar problem. With a bit of modernization, those procedures served for World War II and are still in use.

These functions are not retained in Washington; they are decentralized completely to an Ordnance ammunition center, which also has direct command responsibility for the explosives and loading plants. The trend to decentralize controls out of Washington is not peculiar to ammunition production; it applies to all Army Ordnance procurement.

All this is simply background for the part of the job that occupies the attention of far more Ordnance personnel than the powder, the explosives, the loading and assembly, and the scheduling activities combined; namely, the procurement of the metal components, such as shell, cartridge cases, bomb bodies and fins, and the metal parts for a long list of fuzes and primers. Except for a limited output in two of the old-line arsenals, the chief dependence in the past has been on the conversion of shops in the metalworking industries.

Special-Purpose Tools

Provision of Government-owned machine tools was always required. To get mass output of the metal components, "special-purpose" tools are not needed. Instead, the need is for something quite as difficult to provide—large numbers of "standard" tools in sizes and types quite uncommon in private industry.

Today, taking a leaf from the book of the explosives and loading people, the trend is toward Government-owned plants for more and more of the metal components. The conversion of a sewing-machine plant to the fabrication of artillery fuzes does not take too long—if the needed large multispindle automatics and the required precision drilling equipment are available in storage—but even that simple conversion and subsequent reconversion is disrupting and costly.

On the other hand, the installation of large presses and furnaces required for the forging or extrusion of projectiles or the drawing of steel cartridge cases takes a big expenditure of time and money. It is fair to say that twenty per cent of the cost of such equipment is needed for its installation.

"Both the designer and the producer of ammunition have two goals always before them: to produce continually improved types that are more effective and more efficient than what has gone before; and to be certain that those types are capable of more output with the minimum expenditure of time, manpower, and materials."

This fact has led to the recent establishment, on real estate already owned by the Government, of several large cartridge-case and projectile plants. Some of these plants are shared jointly between Army and Navy Ordnance in order to get flexibility as Army and Navy needs fluctuate. This principle of sharing metal-component plants, now fully accepted by both Ordnance services, is another most important trend of the times.

The current demand for actual end items of ammunition is such that those in charge of production are not worrying too much these days over just keeping alive an adequate capacity for a long list of metal components. They are very busy trying to get more production out of existing lines. Someday, however, that question will come to the fore. How can a state of readiness for the resumption of manufacture of an important metal component, a state of readiness at least comparable to that existing in the explosive plants and the loading plants, be obtained practically and at a cost Government can afford?

Lines on Government real estate are only a partial answer. For one thing, Government real estate which includes suitable buildings is running into short supply. "Capacity in being" in many scattered plants is the only good answer. But can we afford that? The only possible answer lies in the examination of the nature and characteristics of the metal-component capacity created since July 1950.

Allocated Facilities

Most of the existing capacity created since that date has been in the "allocated facilities." These are companies whose interest led them after VJ-Day to prepare the basic planning for fabricating in some future emergency the same components they were making in 1945 (or others quite similar). Most of these allocated facilities are not large.

With the first conservative surge forward in component production in the fall of 1950, Ordnance tried to select facilities that would agree informally to maintain in being for a period of at least five years the lines created by the production contracts.

Some companies that could not afford to set aside space in their existing plants accordingly purchased some existing near-by building that would house their component lines. The greater part of the metal-component production to date has been housed in buildings which have little relation to the normal business of the contractors.

Similar Plans

Quite a number of current contractors have similar plans in mind. Even so, there are not enough of them in a position to give the Government bargain prices for preservation of existing lines. In all too many cases the Government-owned tools and equipment will some day have to be preserved for storage and carried off to Government storage points.

When that happens, the only hope of real preparedness lies in the ability to put away complete balanced lines with no important tools missing.

God forbid that there should occur again any succession of events that would prevent Ordnance from having a balanced reserve of tools for ammunition-component production!

Teamwork for Preparedness

Capital Cities Post of the A.O.A. Aids Defense Production

by

William B. Daley

Local group assists the smaller shops in contract interpretation, specifications, and engineering

THE Capital Cities Post of the American Ordnance Association is rendering a valuable service to the national mobilization program in thirteen counties in upper New York State by becoming better acquainted with large and small business firms in its area in order to function efficiently as a liaison agency between those firms seeking work and those requiring help to expedite work on hand.

Shops Visited

As part of the industrial-survey project, many small shops received a friendly visit from a Post member. These shops were found to be capable of subcontract work in the current industrial mobilization and will most certainly be brought into the battle of production without delay in case of an emergency.

This is the experienced view of John O. Amstuz, a vice-president and chief engineer of the Behr-Manning Corporation of Watervliet, N. Y., who was appointed general chairman of the Industrial Preparedness Survey. Although a busy industrialist with many pressing responsibilities, Mr. Amstuz gave unstintingly of his time and exceptional organizing ability in furthering the survey.

"Our committee was formed to assist industrial concerns in our district to carry out the industrial-mobilization program," Mr. Amstuz asserts. "We are very much interested that all available facilities are most effectively used for the production of armaments and military supplies.

"We are particularly concerned about one of the most vital factors in defense work, namely, the small shop. The small shop is important because of its flexibility. There are many such shops operated by men of imagination, initiative, and know-how—qualities that are seldom found elsewhere. It is in the small shop that you will find born mechanics and excellent craftsmen.

"These men of the small shops can often do things with simple machines and ingenious methods that shops with the very best equipment cannot do. A little assistance to the men running the small shops in engineering, contract interpretation, specifications, and in pooling with other small enterprises makes these small operators a formidable factor in the defense program."

The Human Factor

Convinced of the practical value of these constructive observations, the Amstuz committee set out to coördinate the potential facilities of small enterprises. The committee emphasized the human factor, knowing full well that it is very often relatively simple to tool up and equip a man who knows his business.

In order to do the job quickly and thoroughly, Mr. Amstuz, aided by Vice-Chairman W. B. Daley, formed the following five subcommittees:

1. A Facilities Committee charged with the job of making an inclusive survey of all potential producers or suppliers.

2. A Federal Financing Committee, set up to give financial advice to shops.

3. A Contract Committee, ready to assist shops in getting contracts, primarily subcontracts, from larger concerns. This committee advises operators of shops regarding all phases of contracts—how to go about it, who to contact.

4. A Committee on Job Processing, formed to help the small shop with engineering, tooling up, and advice on tolerances, specifications, and other technical matters. This helps eliminate bottlenecks and overcome difficulties that may arise during the carrying out of a contract.

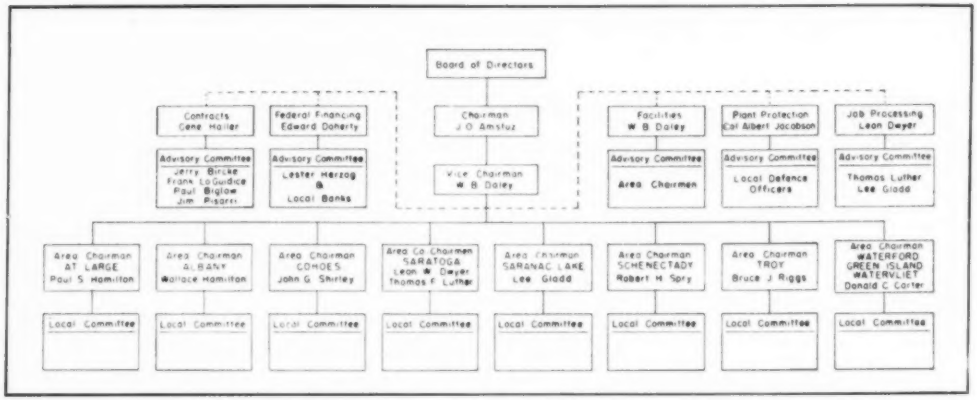
5. A Committee on Plant Protection, giving advice on how to prevent sabotage and how to protect a shop from possible subversive interference.

The following Post members serve as chairmen of the five committees: Gene Haller, Edward Doherty, W. B. Daley, Col. Albert Jacobson, and Leon W. Dwyer. They are assisted, in an advisory capacity, by Jerry Bircke, Frank LoGuidice, Paul Biglow, Jim Pisarri, Lester Herzog, Thomas F. Luther, and Lee Gladd. Local banks and local defense officers were also brought into the survey project.

Area Representatives

The coördination of all committees is done by the following eight area representatives: Paul S. Hamilton, Wallace Hamilton, John G. Shirley, Mr. Dwyer, Mr. Luther, Mr. Gladd, Robert H. Spry, Bruce J. Riggs, and Donald C. Carter. These men know their community and their territory. They know the men operating shops; they know what the shops can do; they know the craftsmen in their respective areas.

Mr. Daley is vice-chairman of the Committee on Industrial Preparedness of the Capital Cities Post of the A.O.A. He is a graduate in civil engineering from Rensselaer Polytechnic Institute.



Organization chart of the Committee on Industrial Preparedness, Capital Cities Post.

The Capital Cities Post made it perfectly clear at the outset that it had no defense contracts to hand out. It was quite successful, however, in bringing numerous prime contractors and subcontractors together. It was able to help and advise the shops that needed and asked for assistance.

Information Distributed

The alert and enterprising Post distributes information on Government regulations, priority rules, and any publication or printed material that may be of value in carrying out defense orders. It keeps in touch with Government authorities, with the procurement offices of the armed forces, and with the National Production Authority and its highly competent Office of Small Business. It helps to coördinate the shops in the district with the work of the local field offices of NPA, the Chamber of Commerce, and the procurement service agencies of the Department of Defense.

"We are convinced," Mr. Amstuz says, "that teamwork and coöperation between prime and subcontractors made the production of armaments and military supplies an outstanding success in World War II. Now we are again called upon to develop all the sources of production to maximum efficiency for the defense program."

Mr. Amstuz gives maximum credit to the technical and human-relations skill of the local area chairmen. In all cases the local area chairmen, whether in Albany, Ithaca, Schenectady, Troy, or Watervliet, are well-known engineers or industrialists who are intimately acquainted with their respective cities and suburbs. This extensive knowledge was of inestimable value in adding many small shops to the Capital Cities Post list of potential producers. If they so desired, the area chairmen appointed a local committee to assist them in making the survey.

In many instances, before a firm was actually visited a preliminary letter was sent out by Mr. Amstuz, calling attention to the fact that American Ordnance Association representation in local business as well as in both the civil and military branches of the Federal Government made it possible for the Association, through its Capital Cities Post, to be of direct value to

industrialists in any future governmental contacts they might have and in working out the fulfillment of any future U. S. contracts they might receive as a prime or subcontractor.

Upon making his visit, the area chairman or his committeeman brings with him a list of Post officers and a Post membership list in order to acquaint the industrialist with the patriotism and solidity of the people interested in the survey. The Post representative then gives the person visited an industrial-survey form, which may be already partially filled out, with the request that it be completely filled out with all the pertinent information that the industrialist cares to offer and returned to Post headquarters.

Forms Classified

Upon receipt of the executed industrial-survey forms by the Post they are promptly classified and indexed in order that Post officials may have instantaneous references on file and thus be in a position to answer any inquiries for firms fully qualified to do prime or subcontract work.

An excellent review of the successful contribution to the defense effort is contained in the following report of Edward B. Doherty, vice-president of the National City Bank of Troy, N. Y. Mr. Doherty has had the capable help of his assistant, Joseph N. Delaney.

Trends Noted

"About two years ago this bank realized the probable trends in war production and certainly had a very clear understanding of what would happen if those trends were accomplished and the country at large was to suffer from the results of the 'roll-over' period, from a fully civilian to a substantially war production activity.

"Immediately prior to World War II and during that war, in coöperation with the then War Production Board, certain officers of this bank were extremely active in the same field of endeavor and were quite successful in helping to stabilize the economy of our

community under comparable circumstances. Early in 1951 this bank signed a contract with the United States Department of Commerce by which it became designated as the Procurement Servicing Agent for the Government, acting through the Department of Commerce.

Contract Vague

"This contract, however, was rather vague, based on a lot of generality, but did provide specifically that a bank so designated shall serve every one in its area, regardless of his business, political, or other affiliation, and it is to be done without charge and without selfish motive.

"We realized that the contract as drawn was merely a starting point and that if we were going to do something concrete we needed a lot of help. As a result we got in touch with John O. Amstuz of Behr-Manning Corporation, the chairman of the Industrial Preparedness Committee of the Capital Cities Post of the American Ordnance Association, Col. Harry N. Rising of the Watervliet Arsenal, and a number of other men of similar standing and position, including officers of the American Ordnance Association.

"We asked for their help and suggestions in the development of the idea of becoming a real servicing agency and not just one in name, and received a most enthusiastic response. All these men, and in fact all the members of Ordnance Association Committees, responded with concrete suggestions and specific help.

"This bank then communicated with most of the official procurement servicing agencies east of Cleveland to Springfield, Mass., and south to Philadelphia, making particular and specific contacts in some of the primary points in Washington, D.C.

"In this original contact it was set forth very clearly that our facilities and the assistance of the Ordnance Association were available to the procurement officers on investigations and checking but that we felt that we could be of greater service in a more particular way.

"We advised them that a letter of introduction or a telephone call from us with regard to any prospective contractor would carry with it the definite assurance that we knew the man to be a bona fide and legitimate businessman and that in our judgment the type of work that he was to discuss with the procurement officer was within his plant's capacity.

"Further, the procurement officer was assured that we had talked with the prospect's bank, wherever it might be, and that we were satisfied that the potential contractor's banking connection would cooperate if necessary in the financing of any prime or subcontract.

Excellent Reaction

"The reaction from every single Government agency was excellent. It is self-evident that such assurance to a procurement officer takes care of two of the major items of his activity; namely, the character and capacity of the man and his plant, plus his financial status. That leaves the procurement officer in a position where he can devote his time to procuring and removes most of the work and worry of investigation from his shoulders.

"The same type of approach was made to a number of prime contractors at the same time—frankly with little immediate success. During the past year and a half, representatives and officers of this bank have at one time or another talked with a great many manufacturers in the area. These manufacturers were urged to 'get their feet wet' before their civilian production began to fall off by starting in a small way in Government work.

Interest Developed

"The idea expressed in the phrase, 'get your feet wet,' seemed to take hold, and as a result of the interest developed a large percentage of the manufacturers in this area obtained through their own efforts a very large volume of defense work.

"It is known by those of us who are reasonably close to the production situation that there are many firms in the area who are now running as high as ninety per cent of their capacity on defense work while a multitude of them are running between twenty-five and fifty per cent. Without this work I hesitate to think what the employment situation might be.

"It has been definitely established that our assistance has proved of real value in the negotiations for prime and subcontracts, in expediting the delivery of raw materials, negotiations with the various armed forces, particularly with respect to Army directives, the speeding up of action on applications for accelerated-depreciation certificates, the proper channeling of applications for priorities, and other governmental negotiations.

"Some rather unusual and exceptional financing has been done with regard to prime and subcontracts. Plant inspections have been made for the Army, and conferences have been held at the suggestion of the V Loan headquarters in Washington in order to straighten out financial affairs of contractors as far as 250 miles away.

Valuable Service

"One of the most valuable services which is now in progress is the forming of a connection with one of the major aircraft companies for the purpose of lining up subcontractors for that company in this area on production schedules to last at least 2½ years. In this instance twelve plants have been specifically approved. . .

"Through the assistance of certain members of the American Ordnance Association we have been able to interest one of the outstanding heat-treatment organizations in the East in the possible establishment of a custom heat-treating plant in the Capital Cities district. In this project we are now in the process of a rather complete survey in which we are assisted by the Ordnance Association, the Department of Metallurgy of Rensselaer Polytechnic Institute, and the New York State Department of Commerce.

"This review has been, as intended, only a highlight, but it covers enough of the activities to give at least an idea of what we are attempting to do."

LOGEX-52

Logistical Exercise To Teach Battlefield Supply

The maintenance of today's complex Army in combat demands coördination of the highest order

ARMY FIELD FORCES' logistical exercise, known as LOGEX-52, being conducted at Camp Pickett, Va., during the week of May 5th, with Maj. Gen. Edward E. MacMorland, commanding general of Aberdeen Proving Ground, as the maneuver director, focuses attention on the vital command function of logistical support to front-line troops.

The purpose of LOGEX-52 is to give student officers of the technical and administrative services practical experience in planning and conducting the operations of those services under assumed combat conditions in the communications zone of an active theater.

Ordnance's conduct of LOGEX-52, the fourth exercise of its kind to be held, is in accordance with a policy of rotating responsibility for such exercises among the technical services. General MacMorland, as maneuver director, is acting for the Chief of Army Ordnance, Maj. Gen. E. L. Ford.

Essential Factor

No branch of military science has proved more essential to the successful employment of modern armies than that which embraces the transport, quartering, and supplying of troops in combat, as well as the establishment of facilities to perform these functions.

The Army's monumental logistical achievements in Korea today, like those of World War II, would not have been possible without long-range planning in the most minute detail—and thorough training of personnel at all levels of command.

Coördination of all the elements constituting the complicated structure of an army in combat today calls for administration and leadership of the highest order.

LOGEX-52 is in accordance with the Army's long-established training doctrine of insuring that commanders in all echelons be thoroughly grounded in the methods of guaranteeing that front-line troops receive the right supplies, at the right time, and at the right place.

In view of the greatly extended supply lines to distant theaters of operation during World War II, and now in Korea, this doctrine has assumed greater importance and added significance.

Simulated Invasion

The concept of the exercise is based on an invasion operation of enemy-held territory by a field army supported by a logistical command. The scope of activity of a logistical command supporting a field army normally involves support of a force of approximately 450,000 men. Tables of equipment specify an authorization for 98,178 vehicles. Supplies needed for such a force are estimated at more than 30,000 tons a day. This tonnage in railway cars placed end to end would extend a distance of fifteen miles.

Faced with combat conditions assumed to exist on D-day plus 65, more than 1,200 officers and 400 enlisted men will be engaged at Camp Pickett in solving the problems of logistical support to such a force. Altogether, more than 3,000 military personnel, including approximately 100 Reserve officers on temporary duty and approximately 50 women trainees from the WAC, will be engaged in the exercise.

In the play of the problems it will be assumed that aggressor forces possess the highest combat capabilities, including that of tactically employing atomic weapons.

Lessons Applied

In participating in the exercise, students will have an opportunity to apply techniques learned at their service schools, especially the interservice teamwork necessary in the detailed logistical support of tactical forces and the logistical requirements for the coördinated support of the Army, Navy, and Air Force.

General MacMorland has described LOGEX-52 as going beyond the normal map and command-post exercise to include great stress on the entire range of problems connected with logistical supporting functions. Problems of administration, transportation, distribution, storage, and maintenance of equipment, and the establishment and maintenance of communication lines and other facilities will all be emphasized.

These problems will extend to the functions of requisition and assignment of personnel, evacuation of casualties, and the welfare of troops.

Plans Prepared

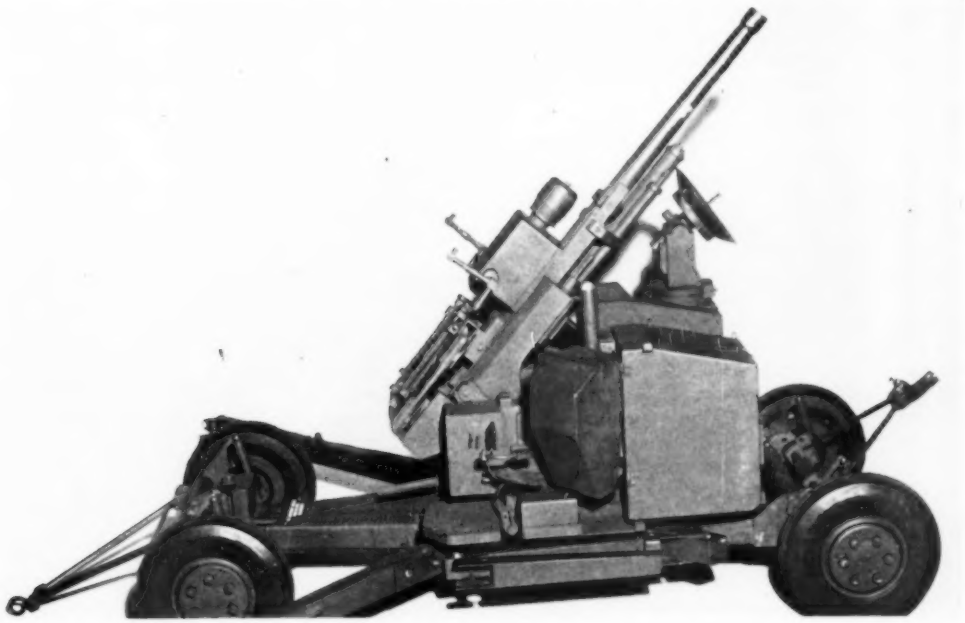
The planning staff for LOGEX-52 assembled at the Ordnance School, Aberdeen Proving Ground, has been busily engaged for several months in detailed preparation of situations requiring participants to exercise imagination and ingenuity in the solution of problems inherent in operations expected in approximately sixty-five days after an assault landing in a strongly held area.

In addition to the participation by service schools, staffs are also being furnished by the Command and General Staff College as well as by the Navy and Air Force.

The lessons learned and the experience gained in LOGEX-52 may well spell the difference between success and failure in any future military action.

Two New Weapons

Shown above is the new attachment developed by Army Ordnance for the caliber .45 submachine gun M3 which can deflect a bullet at a 90-degree angle, permitting fire around corners! Below is the long-secret "Skysweeper"—a completely automatic 75-mm. antiaircraft gun which is the Army's answer to the low-flying strafing and bombardment plane (Army photos).



Month by Month: Highlights of the National Defense

Procurement Difficulties

Rear Adm. Morton L. Ring, Munitions Board Vice-Chairman for Supply Management, sounded a very timely note in speaking of the dilemma of the military procurement officer these days. His statement before a committee of the House of Representatives for the first time, to our knowledge, brought into public focus the almost hopeless and impossible situation which confronts military procurement officers under today's conditions.

> *The Munitions Board was defended by Admiral Ring, and its efforts to coördinate the procurement activities of the three armed services were described in full. Students of industrial mobilization have no complaint with the philosophy of the Board, although valuable time has been wasted in the past in getting its work actually under way.*

This situation has not always been the fault of the Board itself but rather of the interminable red tape in which the Board and all other procurement agencies find themselves enmeshed these days in trying to get and then to unravel action by the controlling authorities. Truth to tell, one of the most damaging episodes in the history of industrial mobilization was those many, many months—indeed, years—between the end of World War II and the beginning of the Korean War when the National Security Resources Board utterly failed in its key responsibilities. With that major part of the machine out of gear there was little else that the Munitions Board, and in turn the defense services, could add to make up for its deficiencies.

However, the following excerpt from the testimony of Admiral Ring is a clarion call to our political leaders that a decision must be made quickly as to whether or not the social implications of government buying are to continue to take precedence over military necessity. Here Admiral Ring sounded off in a fashion to warm the hearts of those who are increasingly concerned about government red tape as expressed in our rising involvement in statism. We now seem to be getting into an armament economy, and the armament economy is being used to advance social theories which are a far cry from military preparedness as such. Here is the stenographic transcript of Admiral Ring's comment:

"Mr. Doyle asked me a question with regard to procurement as it relates to the catalogue. What we have today—and I speak now as an old-time purchasing officer—are so many different impacts pulling and hauling upon the purchasing agent. Congress has enunciated a small-business policy. Mr. Wilson has issued a directive which is known as ODM Directive No. 4, which says, 'Let's give special attention to distressed areas.' We have a big program of off-shore procurement. We have a statute called the 'Buy-American Act.'

> *"We have today, I will recite them if you want me to, at least fourteen major policies under which your purchasing officer is working; and I don't care how good a catalogue he has and how good a specification, there are factors which are going to affect every single procurement that is made.*

"Yes, you have price control. Yes, you have people who would say 'negotiate all your contracts so that you can direct your contracts to small business or to a distressed area.' You have also got a committee of this House, a committee of the Senate, select committees on small business, which say 'formal advertisement and competitive buying is the best way for a small-business man to get in.'

"If you would ask me today, if I were a purchasing agent, which one of these directives I would follow, I would tell you, sir, that I would follow the one on which the pressure was greatest right now, and then duck.

"I am simply saying that today's procurement is affected by many different influences. There are those, Mr. Congressman, who would use the military appropriations for the solution of a lot of social problems. I happen to believe that the single, sole function of a military procurement officer is to get the most he can of what is needed within the time required to the specifications desired at the lowest net cost to the taxpayer. And I am telling you that today that problem is most difficult of achievement. I feel rather strongly on the subject."

The Admiral is to be congratulated on his fearlessly frank statement. It is high time that we get down to brass tacks; if we really intend to rearm we should do so without the countless hurdles that now slow us down. The American fighting man is the individual whose interests must be made paramount—and after him the American taxpayer.

Two Conversion Plans

Two of America's foremost industrial leaders, C. E. Wilson, president of General Motors Corporation, and Charles E. Wilson, formerly Director of Defense Mobilization and president of General Electric Company, have made two very valuable and farsighted suggestions to insure industrial preparedness and to conserve some of our current defense expenditures into lasting benefits for the American people.

> *These thoughtful suggestions richly merit the serious consideration of every patriotic citizen who is interested in the preservation of our free economy.*

Mr. Wilson of General Motors believes that we should integrate our military and civilian production facilities. In an address delivered at the Thirty-Third Annual Meeting of the

American Ordnance Association in Cincinnati on October 4, 1951, he declared that if we are to have an adequate and flexible mobilization plan for an indefinite period, we must develop ways and means for integrating capacity for the production of military material with the production facilities required for the manufacture of consumer and producer goods normal to a peacetime economy.

"We cannot afford either the time or money incidental to the acquisition of facilities for the production of military material each time a war or threat of war disturbs us," he said.

Mr. Wilson proposed that manufacturers who are expected to assume responsibility for the production of the larger and highly technical military items be prepared to operate dual-purpose plants which can be used in three ways: for combined production, for total war production, or for total civilian production.

"New plants," he asserted, "now being constructed as part of the defense and essential civilian program should be constructed with this objective, and existing facilities, as they are partly changed to defense production, should be organized so that they are flexible for these same three purposes."

> *The major advantages of dual-purpose plants are economy, the utilization of standard plant equipment—such as cafeterias—for civilian and military purposes, the availability of skilled employees, the possibility of quick conversion from peace to war production, and the general strengthening of our industrial-preparedness program to meet any eventuality.*

Mr. Wilson, of General Electric, offers a plan under which American citizens who hold United States defense bonds would become the ultimate stockholders in privately operated peacetime industries growing out of atomic plants, power installations, and other emergency facilities.

In an address sponsored by the Chicago Association of Commerce and Industry, Mr. Wilson urged business and industrial leaders to be guided, wherever possible, by the concept of thinking ahead in planning military construction so that the maximum advantage would accrue to the civilian economy when the need for military production lessens.

Mr. Wilson said that facilities now being built or put into use for defense purposes, including atomic plants, power plants, and convertible military matériel plants, should be offered as an investment to the 150,000,000 people of America.

"The plants should be privately owned and managed," he said, "and their stock offered for purchase by all the people interested, thus greatly enlarging the base of ownership in the industrial tools of America's productive capacity. I further suggest that this stock not be sold for cash but exchanged for Government savings bonds up to a certain limit per person. This would make savings bonds more attractive as the medium of purchase of a share in America's productive machine of tomorrow—with the old and tried incentives for profit, along with the risks, of course."

> *Mr. Wilson expressed the view that his plan would ultimately reduce the national debt. Government would have to pay out less in interest charges. It would receive income taxes from the new company. It would receive income taxes on the dividends. It would not be liable for operating expenses, including payrolls, and for losses. Finally, local communities would receive real-estate and other taxes.*

Mr. Wilson said he would extend this process not only to currently constructed defense plants, but to other presently owned Government institutions "susceptible to profitable operation by widespread ownership and private management wherever the national debt could thus be reduced and more impetus given to the American way."

Mr. Wilson declared that this scheme would "give a very practical answer" to the question of whether the United States was still "sold on the system that made it the greatest and the most powerful nation on earth."

The Record on Costs

The Department of the Army declared that recent reports alleging wide discrepancies in prices paid by it for identical items were misleading and based on misconceptions and incomplete information.

> *Since the reports created an impression of uneconomical procurement policies, it has made a thorough study of them, the Army said. The results showed that various and sound reasons existed for certain variations in price.*

The reports, for example, listed the price paid by Army Ordnance for extension cords as $6.52 each, as compared with $13 alleged to have been paid by the Army Corps of Engineers. Investigation revealed that the Ordnance price was based on the procurement of 6,900 extension cords in June 1951, whereas Army Engineers have never purchased this item.

The $13 figure was only an estimate by the Chicago Procurement Office of the Corps of Engineers, and was based on information supplied by private industry.

The Department of the Army also pointed out that standard commercial extension cords are not comparable to those purchased by Army Ordnance which are manufactured in accordance with Army specifications for use by troops in severe atmospheric conditions.

Reports also claimed that in the procurement of 25-watt light bulbs Army Engineers paid 11 cents for each of these items, while the Army Medical Corps paid 13 cents, and the Army Signal Corps paid 37 cents each. Current price for these bulbs at two leading chain stores checked is 14 cents each.

The Department of the Army indicated the special circumstances that were involved in the Signal Corps purchase.

A contract was awarded to a camera company of New York for so-called "spotting sets." These are precision phototheodolites primarily used in anti-artillery practice. The contract called for numerous major and minor components, plus technical manuals and

some 400 different maintenance items, including the light bulbs, which required special packing and individual handling.

In such purchases the normal procedure is to award the contract to the bidder whose over-all price for the complete equipment and the maintenance parts is the lowest.

In a nationwide radio and television broadcast, however, former President Herbert Hoover stated that "the outstanding phenomenon in the United States is the dangerous overstraining of our economy by our gigantic expenditures."

> *He directed attention to the fact that "we are confronted with a probable Federal deficit of 30 to 40 billions for immediate rearmament. We already have Government obligations and currency of $280,000,000,000, and private credit is dangerously overexpanded. In the brief period since the war, private credit has swelled by $130,000,000,000."*

He predicted that "our standard of living will be reduced in millions of families. Life savings will be taken from millions of other families. Rising prices are coming through the kitchen while taxes are invading our homes through the front door."

European Arms Production

The three military services are beginning to place contracts for the production in Europe of military equipment. (For a detailed report on this subject see the April issue of the Association's Monthly Washington newsletter—THE COMMON DEFENSE.)

The program has been designed to help the North Atlantic Treaty nations strengthen their military productivity, speed the equipping of NATO military forces, and hasten the time when the United States can be relieved of the burden of foreign military contributions.

> *The aim of the Overseas Defense Production program is to fill in present gaps in Western Europe's military production base in order to provide substantial local logistic support of NATO forces and to enable European nations to maintain major items of military equipment shipped from the United States.*

Proponents of the program claim that if Western European nations are successful in building a self-sustaining armament industry, the demands on American arms production can gradually be reduced and supply lines will be greatly shortened. But not all students of our economy agree with this philosophy.

Approximately $620 million has been programmed by the three services. This initial program represents about 11 per cent of the 1952 fiscal year foreign military aid appropriation.

The bulk of the initial program will be ammunition items, spare parts for certain combat and transport vehicles, small craft and auxiliary vessels, and certain aircraft spare parts.

Army Conserves Metal

The Department of the Army reported that the substitution of steel in small-arms ammunition alone was expected to save more than five million pounds of copper during the first quarter of 1952.

Actual conservation of copper during the previous quarter in the production of small-arms ammunition amounted to 3,675,587 pounds.

> *This is one concrete result of the Army's present intensive campaign to eliminate or reduce the use of critical materials without sacrificing essential military or safety features.*

Specifications for guns, incendiary bombs, belt fasteners, medical-service items, weapon mounts, radio sets, hospital beds, and even harbor tugs, in addition to scores of other items, have all undergone changes which conserve materials in short supply.

Artillery ammunition cases are now made of steel instead of brass, with the exception of 120-mm. ammunition. Improved methods of producing fuzes, boosters, and rotating bands in artillery shells promise to reduce further the copper requirements in this field.

Savings in the production of small-arms ammunition stemmed from the use of a clad steel jacket, formerly made of a copper-zinc alloy.

Copper also has been eliminated from many small items, such as snaps, springs, buckles, and locks, with plated steel replacing the copper.

The Army also has adopted boron and lean alloy steel in the manufacture of guns, gun mounts, and tank and truck parts, since these types of steel can, in some cases, replace alloy steel which contains larger amounts of critical nickel.

Airborne on Wheels

"No Vehicle Remains Behind" was the amazing motto of the 782nd Airborne Ordnance Maintenance Company of the 82nd Airborne Division recently when the division's 2,250 vehicles and 1,900 trailers rolled a total of almost 4,000,000 miles to move the airborne outfit from Fort Bragg, N. C., to Fort Hood, Tex., for Exercise Long Horn, joint Army-Air Force training maneuver.

> *Statistics released by Lieut. Col. William H. King, Jr., Division Ordnance Officer, indicate that the division's mechanics and the Ordnance company achieved an almost perfect record in "keeping 'em rolling."*

Only three vehicles and a trailer were left along the 1,600-mile route. All but one of these could have been kept rolling with emergency repairs if supply economy had not dictated that they be left behind for a thorough check.

The Ordnance company, responsible for the supply and maintenance of artillery, small arms, instruments, and tanks, in addition to the vehicles, normally kept sixty tons of spare parts on hand. But since the 82nd Airborne Division is completely equipped with the "M" series type of vehicles, an additional 40-ton stock was laid in because very few parts of this type were available along the way or at Fort Hood.

Ordnance detachments handled 230 repair jobs, 90 of which were major unit replacements or repairs, such as change of a transmission or an engine.

Air Force Armament Policy

An Editorial

SEVERAL months ago the United States Air Force announced its policy for the development and procurement of Air Force armament. The policy has many most attractive features, not the least of which is the utilization to the fullest extent of the facilities of private research and of private industry for the development and production of needed equipment. Much good should come from the new declaration—good both in the way of superior armament and also from the standpoint of efficiency and economy in so far as Government expenditures are concerned.

It should be said at the start that, in the parlance of the Air Force, "armament" is synonymous with "ordnance." Thus as armament the Air Force includes guns, ammunition, and explosive materials such as bombs, propellants, rockets, pyrotechnics and incendiary compounds, protective armor, equipment for dispensing toxic and biological-warfare materials, sights, computers, launchers, and control systems, together with components, accessories, supplies, fixtures, handling, training, analyzing, maintenance, and test equipment therefor.

Statement of Policy

The policy itself is crystal clear both in its philosophy and in its expression. We quote it verbatim.

"(a) Combat aircraft will be considered as complete weapons systems from conception to the end of service life. This concept requires the integration of armament equipments in future aircraft design proposals.

"(b) The Air Force will emphasize, encourage, and support the development of armament activities within United States industry which will insure research, development, and production capacity in times of peace as well as in war.

"(c) The development and procurement of all Air Force armament equipment is the responsibility of the Air Force. In consonance with the principle of cross-servicing, other Government agencies and facilities will be utilized to the maximum extent consistent with furthering the objectives of the Air Force armament program.

"(d) The Air Force will establish a career field in Air Force armament to attract and retain qualified personnel. Personnel assignments will be carefully monitored to achieve this objective.

"(e) The Air Force will continue to develop the technical training program in Air Force armament to achieve maximum competence in military and civilian personnel in all areas of armament.

"(f) The Air Force will develop and construct such integrated systems of facilities as may be required to insure complete and comprehensive development, testing, and evaluation of armament equipments."

Students of armament progress see in the above policy the results of years of experience which have characterized the activities of the Ordnance Department of the Army and the Bureau of Ordnance of the Navy. The dominant note in these experiences has always been the utilization of private industry for the purpose of specific undertakings, both in the fields of research and development and also in the fields of production and maintenance. It is only in recent years—since the advent of World War II in fact—that these time-honored policies have been violated by the erection and operation of huge Government facilities where private facilities formerly were used.

Equally important is that phase of air-armament policy which provides for the establishment of a career field "to attract and retain qualified personnel."

The Ordnance fraternity since the days of the great Army Ordnance leader, Maj. Gen. William Crozier, has been noted for its specialist training. To be an Ordnance Officer means to be a career specialist whose special engineering and administrative skills mark him as a leader in the unusual fields of technology wherein few others are qualified.

The Air Force announcement on this score will warm the hearts of all those who have watched the weakening of this time-honored professional attitude. It is one thing to command an army in the field—or an air force aloft. It is quite something else to design, develop, and produce the armament without which armies and air forces are impotent.

It is apparent in this latest declaration of policy that dependence upon private facilities both for research and production is again coming to the fore. The three armament organizations—Army, Navy, and Air—have a vital function to perform, and that function is best performed when private facilities rather than governmental establishments are utilized to maximum extent. Such a policy augurs well for the future of American ordnance, both in quality and in cost. Thus is translated into operation by the Air Force the philosophy of superior air armament which was so well expressed recently by Thomas K. Finletter, Secretary of the Air Force:

"Emphasis upon Machines"

"I have already referred to the emphasis which possible enemies are placing upon their air defense. The corollary of this is obvious—we must place a corresponding emphasis upon the machines which may have to deal with these air defenses.

"The same need for quality applies to our own air defense. With modern weapons of the violence of the atomic bomb in the hands of possible enemies we should concentrate heavily on the quality of the machines which may have to deal with enemy bombers which would carry these dreadful weapons."

ASSOCIATION AFFAIRS

• **AT WASHINGTON.**—The Ordnance Association in 1951 had its greatest year of activity in all fields of operation. Its meetings—national and regional, the programs of its forty-two local Posts and Chapters, the output of its forty-eight permanent Technical Divisions and Committees—all combined to provide the greatest period of service to the national defense since the Association was formed in 1919.

These results, as well as the policies governing the operations of the Association, were presented and discussed fully at the annual meeting of directors and officers held in the Carlton Hotel, Washington, D. C., throughout a day-long session on March 5, 1952.

There were present at the meeting: James L. Walsh (New York), president and director, who presided; Herbert A. Gidney (Pittsburgh), vice-president; Harvey C. Knowles (Cincinnati), vice-president; Louis Polk (Dayton), vice-president; Robert L. Biggers (Detroit), vice-president; John S. Pfeil (Boston), vice-president.

The following directors were also present: Levin H. Campbell, Jr. (Chicago), Donald F. Carpenter (Wilmington), C. Stewart Comeaux (New York), R. E. Gillmor (Washington), E. R. Godfrey (Detroit), Frederick H. Payne (Springfield, Mass.), and J. E. Trainer (Akron).

Henry N. Marsh (Wilmington), general chairman of Divisions and Committees, and the following officers connected with national headquarters also attended: Leo A. Codd, executive vice-president; Florence G. Ferriter, secretary; Roger E. Lewis, managing editor; and Burton O. Lewis, staff consultant.

Notable among the reports submitted was that of President Walsh who wrote, in transmitting his report:

"If the battle is the pay-off, then our 33,561 members may well be proud of the following appraisal of the culmination of their 33 years of ceaseless activity in the field of industrial preparedness:

> The efforts of the American Ordnance Association in arming and equipping United States Forces operating in Korea have made an incalculable contribution. In fact, I would say that without those efforts we could not have succeeded.
>
> MATTHEW B. RIDGWAY
> *General, Commander in Chief*
> *Far East Command*
> January 12, 1952

"Atomic Ordnance is the challenge which now confronts us, as emphasized in the following call to action:

> The members of the American Ordnance Association have always helped to lead the way in the development of arms and material so that our men can enjoy absolute confidence in their weapons.
>
> The introduction of atomic energy and atomic ordnance brings all of you a new challenge, which I know you will meet. I am confident that your scientists, engineers, and industrialists will keep us in the forefront in this field. Our victories depend on our men and our arsenals and our patriotic citizens.
>
> OMAR N. BRADLEY
> *General of the Army*
> *Chairman, Joint Chiefs of Staff*
> December 4, 1951

"The two cited statements epitomize our past performance—and the challenge of the future. The principles which have guided the Association from its founding to its present eminence are discussed at some length in my report for the year 1951, which I have the honor to transmit herewith." The president also reported:

1. That a nominating committee under the chairmanship of Harry Erlicher, and consisting of the following members: Edward T. Gushée, George F. Hussey, Jr., James D. Maitland, Paul O. Vogt, and President Walsh, *ex officio*, had submitted its report nominating the following members at large of Council to serve until December 31, 1952, or until their successors are chosen:

Donald Armstrong	Henry N. Marsh
G. M. Barnes	William H. Mitchell
H. G. Batcheller	Clyde H. Morgan
Thomas F. Brown	Thos. E. Murray, Sr.
Harry A. Bullis	K. T. Norris
Irving A. Duffy	Walter C. Pew
Robert C. Enos	Wm. J. Rushton
Britton L. Gordon	Lewis L. Strauss
John M. Hancock	H. M. Tillinghast
Arnold Hauser	Raycroft Walsh
Walter N. Howley	J. Carlton Ward, Jr.
H. P. Lawrence	Thomas J. Watson

2. That these nominations had been submitted to the members of Council representing Posts and Technical Divisions and the charter national officers and directors who, by letter ballot, elected all of them to serve as members at large of Council for the period stated.

3. That a nominating committee appointed by Col. W. W. Coleman, chairman of Council, and consisting of Mr. Erlicher as chairman, Mr. Brown, Mr. Gushée, Mr. Howley, Admiral Hussey, Mr. Maitland, Colonel Morgan, Mr. Vogt, and President Walsh, *ex officio*, had nominated the following directors of the Association to serve for the 4-year period beginning January 1, 1952, and ending December 31, 1955: Mr. Carpenter, Major Comeaux, Henry L. Clark, Ben Moreell, and Mr. Trainer.

4. That, by letter ballot to all members of Council, these directors thus nominated had been elected for the period indicated.

The Executive Committee consisting of the following—Colonel Gidney, Mr. Knowles, Mr. Polk, Mr. Biggers, Mr. Gillmor, C. Jared Ingersoll, President Walsh, and the following *ex officio* members: Henry P. Erwin, John Ross Delafield, Colonel Codd, and Miss Ferriter—was reëlected to serve for the calendar year or until their successors are elected.

The Advisory Board consisting of the following—J. D. Biggers, Russell E. Gardner, Jr., Earl B. Gilmore, T. M. Girdler, A. W. Herrington, B. T. McNeil, Thomas A. Morgan, John M. Olin, S. E. Reimel, James W. Wadsworth, and Charles E. Wilson—was reëlected to

Aberdeen Proving Ground	$ 405.75	**Midwest (Kansas City)**	$ 185.50
Birmingham	398.75	**Milwaukee**	1,315.75
Capital Cities (Watervliet)	258.25	**Nebraska (Omaha)**	93.75
Central Illinois (Peoria)	108.25	**New York**	3,341.92
Chicago	2,491.00	**Northwest (Minneapolis)**	334.75
Cincinnati	2,229.00	**Philadelphia**	2,405.49
Cleveland	3,480.25	**Pittsburgh**	1,582.75
Columbia River (Portland)	79.00	**Puget Sound (Seattle)**	152.25
Empire (Rochester)	1,276.25	**Quad Cities-Iowa (Rock Island)**	381.25
Florida (Eglin Field)	35.00	**Rocky Mountain (Denver)**	215.00
Hartford-Springfield	1,314.50	**St. Louis**	893.00
Lone Star (Dallas)	144.75	**San Francisco**	377.75
Los Angeles	881.75	**University of Michigan**	55.75
Louisiana (New Orleans)	140.50	**Texas (Houston)**	217.25
Michigan (Detroit)	5,636.73	**Washington**	581.50
Mid-Continent (Tulsa)	149.25	**Yankee (Boston)**	1,471.00

Refunds made to local Posts of the Association during 1951.

Washington Post visits Rheem Manufacturing Company Plant, Sparrows Point, Md.

Shown inspecting the Rheem-developed hermetically sealed, shock-mounted container for aircraft engines are, left to right: Lieut. J. J. Forst, materials assistant, Bureau of Ships, U. S. Navy; Col. Robt. W. Meals, chief, Logistics Division, National Guard Bureau, Washington, D. C.; G. G. Tucker, Rheem Manufacturing Company, Sparrows Point, Md.; R. P. Williams, Jr., Rheem vice-president, Washington, D. C.; and Leo A. Codd, executive vice-president of the American Ordnance Association, Washington, D. C.

serve for the calendar year 1952 or until their successors are elected.

Notable among the other reports were those of Colonel Erwin, the Association's treasurer; Miss Ferriter, the secretary; and Mr. Lewis, managing editor of A.O.A. publications.

The treasurer reported that the annual audit of the financial records of the Association was prepared by Ernst & Ernst, certified public accountants, as of December 31, 1951, showing receipts from all sources as $484,715.49 and expenditures of $419,500.46.

The principal sources of receipts were:

Membership	$226,624.96
Magazine subscriptions	7,224.69
Advertising	159,312.89
Book service	3,248.30
Interest	20,813.52
Meetings	65,274.88
Miscellaneous	2,216.25

The principal purposes of expenditures were:

Membership administration	$106,410.07
Local Posts	41,308.61
National Divisions	18,769.78
ORDNANCE magazine	154,764.76
Bulletin and newsletter	20,688.72
Meetings	77,558.52

The budget of estimated receipts and expenditures for the year 1952 was submitted by the executive vice-president. It disclosed anticipated revenues of $482,000.00, and expenditures of $472,000.00.

Highlights of the secretary's report were:

1. *Membership:* As of December 31, 1951, there were 30,879 regular members, 711 life members, 642 associate members, and 1,329 company members—a total of 33,561.

2. *Extension:* Approximately 165,000 invitations to membership were sent by National Headquarters to prospective members with accompanying literature.

3. *Refunds to Local Posts:* Local Posts of the Association receive, as refunds from membership dues, $10.00 from life members, 50 cents from regular members who pay $4.00 annually, $1.25 from regular members who pay at the special rate of $10.00 for three years, and $12.50 from company members. These refunds are computed from day to day and are remitted to the treasurers of Posts quarterly. During the year refunds were made to Posts as shown in the table opposite.

Issue	*Press Run*	*Total Pages*	*Pages of Features*	*Pages of Departments*	*Armament Technology*
Jan.-Feb.	**35,000**	**108**	**36**	**11 5/12**	**10**
Mar.-Apr.	**35,000**	**132**	**34**	**13 3/4**	**18**
May-Jun.	**35,000**	**156**	**38**	**16 2/3**	**12**
July-Aug.	**36,000**	**164**	**36**	**13 2/3**	**14**
Sep.-Oct.	**37,000**	**174**	**36**	**12**	**12**
Nov.-Dec.	**37,000**	**180**	**29**	**13**	**20**

Principal statistics for ORDNANCE magazine for 1951.

4. *Book Service:* The Ordnance Books of the Month selected by the editorial staff for each month of 1951 were: "Defence of the West" by B. H. Liddell Hart; "The Front Is Everywhere" by Lieut. Col. William R. Kintner; "Rommel, the Desert Fox" by Brigadier Desmond Young; "The Navy and the Industrial Mobilization in World War II" by Robert H. Connery; "Generals and Politicians" by Jere Clemens King; "The Riddle of MacArthur" by John Gunther; "A Soldier's Story" by Gen. Omar N. Bradley; "The MacArthur I Know" by Gen. George C. Kenney; "George Washington" by Douglas Southall Freeman; "The Forrestal Diaries" edited by Walter Millis; "Closing the Ring" by Winston S. Churchill; "The Machine Gun" by Lieut. Col. George M. Chinn.

During the year there were approximately 800 books sold. Receipts were $3,248.30; expenditures $2,974.78 (exclusive of overhead).

5. *Personnel:* Throughout the year the National Headquarters staff consisted of eighteen paid employees. The annuity retirement plan was continued. Two employees, each having served the Association continuously for ten years, were added to the annuity retirement plan, and annuity policies were purchased for them. All employees of the Association are enrolled under the Social Security Act, and all are under Group Hospitalization.

Ten of the Association's employees have been in continuous service more than five years. Seven of these employees have been in the employ of the Association more than ten years and are enrolled under the annuity retirement plan. All personnel at national headquarters have developed skills peculiar to national association procedures which contribute materially to the smooth and efficient operation of national headquarters. Their loyalty and industry have been demonstrated in exceptional ways throughout the year.

Highlights of the managing editor's report were:

1. ORDNANCE *Magazine:* The principal statistics for this publication are shown in the table on this page.

2. *Ordnance Directory:* Section II of ORDNANCE magazine which was published as part of the March-April and September-October issues contained a directory of (a) the officials of the Association, (b) the officers and directors of all local Posts, (c) the members of the Technical Divisions and Committees, (d) the Honor Roll of the company members of the Association, and (e) a current organization chart of the Association.

3. THE COMMON DEFENSE: The average press run of the Association's monthly Washington newsletter to members was in excess of 35,000 copies.

4. INDUSTRIAL PREPAREDNESS: The Association's monthly report to members on the progress of industrial mobilization also had an average press run in excess of 35,000.

5. *Special Reports:* In addition to these regular publications the editorial department processed a large number of miscellaneous publications and printed pieces. During 1951 these included the following brochures:

a. "Organization for Defense Production," by W. W. Storey;

b. "Ordnance Pricing and Financing," by Ross Pancoast;

c. "Gages for Ordnance Production," the proceedings of the annual meeting of the Gage Industry Division, January 12, 1951;

d. "High Precision Antifriction Ball Bearings," a transcript of a seminar spon ored by the Instrument Jewel Bearings Committee;

e. Report of the Torque Test Subcommittee, Instrument Precision Ball Bearings Committee;

f. Proceedings of the Spring Meeting of the Rocket Committee;

g. Life Membership Plan;

h. Roster of A.O.A. Life Members;

i. Organization and Activities of the A.O.A.;

j. Programs and seating lists for the Annual Meeting in Cincinnati and for the Industrial Preparedness Dinner in New York.

Brig. Gen. Burton O. Lewis reported on the Technical Divisions and Committees as follows:

"At the present time there are slightly less than one hundred active technical groups functioning within the organization of the National Technical Divisions and Committees of the American Ordnance Association, consisting of divisions, executive boards, committees, special committees, and subcommittees. The major technical groups are organized on a permanent basis, but many of the special committees and subcommittees are temporary, depending upon the nature of the problems under consideration. Technical groups for which there is no present or prospective need are deactivated.

"Members of the Association's technical groups are, almost without exception, key men of American industry. The chairmen constantly endeavor to conserve the time of these busy committee members by avoiding unnecessary meetings and by conducting all formal meetings as expeditiously as possible. The views and comments of the members of a committee can sometimes be adequately obtained through correspondence, and this method of securing information is frequently used by committee chairmen.

"There are presently about 1,000 members of the American Ordnance Association participating in the activities of the Technical Divisions and Committees. These gentlemen are giving freely of their time and talents as individual patriotic citizens interested in contributing to the national defense and, of course, without compensation. They are extremely enthusiastic about the work and are always anxious to do more.

"In accordance with instructions of the Board of Directors issued at its last meeting, a special committee met at the Eglin Air Force Base, Florida, on February 21, 22, and 23, 1952, for discussion with the authorities at that base of their requests for technical assistance from the Ordnance Association in connection with the instrumentation and facilities in use at that proving ground for the testing of aircraft armament.

"This special committee consisted of Ralph Goetzenberger, Minneapolis-Honeywell Regulator Company, an expert on scientific instruments, gyros and control equipment; Henry N. Marsh, Hercules Powder Company, an expert on powder and explosives, rocket powder, and explosives safety; H. O. Winn, General Electric Company, an expert on electronics and related equipment."

John S. Pfeil, chairman of the Committee on Life Membership, reported that as a result of the activities of his committee during the past year seventy-six new life members had been enrolled. He also reported that plans are under way for an active campaign for the enrollment of life members during 1952.

Brig. Gen. Burton O. Lewis, center, staff consultant for A.O.A. Technical Divisions and Committees, addresses members of the Florida Post during a conference at the Armament Center at Eglin Air Force Base, Florida.

• **AT SAN FRANCISCO.**—An historic meeting of the San Francisco Post was held on the evening of Friday, April 4th, at the Palace Hotel, San Francisco, when nearly 200 members and guests assembled in observance of the Post's twenty-ninth birthday.

Dr. Alonzo Baker, professor of political science and international relations, College of the Pacific, was the principal speaker. Edgar B. Jessup, president of the Post, who is also president of the Marchant Calculating Company, Oakland, Calif., presided. Philip J. FitzGerald, a director of the Post, was toastmaster.

Among the honor guests were Col. Dean Witter, chief of the San Francisco Ordnance District, and Col. Hans G. Jepson, deputy district chief. Leo A. Codd, executive vice-president of the Ordnance Association, also addressed the meeting.

The San Francisco Post of the Association was established in 1923, being the second of the Association's Posts to be formed in industrial centers. Throughout the intervening years the Post has taken an important part in keeping alive an interest in ordnance preparedness throughout the West Coast area. It is the parent Post of the Los Angeles, Portland, and Seattle Posts.

Arrangements for the meeting were in the capable hands of Lieut. C. H. Wuerz, secretary of the Post, whose organizational ability and fine attention to detail resulted in one of the most significant meetings thus far held by the Ordnance fraternity on the Pacific Coast.

• **AT LOS ANGELES.**—The annual dinner meeting of the Los Angeles Post was held at the California Club, Los Angeles, Calif., on the evening of February 29th. The principal speaker was Dr. Kenneth McFarland, educational consultant to the General Motors Corporation. Dr. McFarland's subject was "Four Buckets of Paint"—an inspirational address on patriotic service based on thrift, coöperation, and hard work.

Dr. McFarland stressed the fact that perhaps the biggest danger confronting successful individuals and organizations is that they stop doing the things that made them successful when they reach the top.

He compared success with a white house and stated that in order to keep the house white it must be painted from time to time. The "four buckets of paint" were: (1) Too many people quit looking for work after they find a job; (2) "When you pitch the hot potatoes to somebody else you usually lose the gravy, too"; (3) Always look for reasons why you can do things rather than reasons why you cannot; (4) There is no market for cynics.

William A. Wilson, Web Wilson Oil Tools Company, Los Angeles, president of the Post, was toastmaster for the meeting. Henry L. Clark, a director of the national Association and manager of the General Motors Plant at South Gate, Calif., addressed the meeting on the principles and aims of the American Ordnance Association.

Aubray Austin, deputy chief of the Los Angeles Ordnance District, described the activities of the district. Approximately 320 members and guests were in attendance.

One month later, on March 29th, members of the Los Angeles Post visited the Long Beach plant of the Douglas Aircraft Company. One hundred and twenty-five members of the Post participated in this field trip, attendance being limited by security regulations of the Douglas Company.

Following the plant visit, members were guests of the Douglas Company at a delightful luncheon served in the company cafeteria. After luncheon an address was given by Leo A. Codd, executive vice-president of the Association, and two films were shown, the Douglas C-124 transport in action and the A.O.A. film, "Ordnance Air Power for Peace."

• **AT HANOVER, N. H.**—A new Chapter of the Yankee Post was established at Dartmouth College on February 28, 1952. At the inaugural meeting the principal speaker was Maj. Gen. R. L. Maxwell, vice-president, American Machine & Foundry Company, who described the important national-preparedness work being carried forward by the Association. A former editor of this magazine and a former executive secretary of the Ordnance Association, General Maxwell is a valiant friend and proponent of ordnance progress.

After hearing General Maxwell's timely and significant address, Dartmouth students were very enthusiastic about the Association's current accomplishments and eighty-four immediately applied for membership.

A business meeting was promptly convened and an election of officers and directors was held. Edward J. Spiegal, '53, Glencoe, Ill., was elected president of the new Chapter, and Oliver B. Conover, '53, Spring Lake, N. J., was elected vice-president.

In addition to these two officers, the following students were elected to the board of directors: Frederick C. Niles, '53, Shrewsbury, N. J.; Julian L. Robinson, '53, New York, N. Y.; Donald E. McMichael, '53, Denver, Colo.; Edward E. Hobbie, '54, South Deerfield, Mass.; John B. Jameson, '54, Denver, Colo.; and Robert L. Woodberry, '54, Waban, Mass.

Dean William P. Kimball, Thayer School of Engineering, and Lieut. Col. W. B. M. Chase, professor of military science and tactics at Dartmouth, were selected by the students as the faculty advisers for the new Chapter.

Lynn H. Morse, president of the Yankee Post, was advised by Colonel Chase of the results of the inaugural meeting on the Dartmouth campus. The application of the Dartmouth students for affiliation with the Yankee Post was approved by the Post board of directors.

Speaking for Mr. Morse, John C. Dieselman congratulated the members of the new Dartmouth Chapter, welcomed them most cordially into the Association, and extended to them a most hospitable invitation to take part in the scheduled activities of the Yankee Post.

• **AT COLORADO SPRINGS.**—Gen. Benjamin W. Chidlaw, Commanding General of the Air Defense Command, was cited for outstanding service to the Nation by the American Ordnance Association in presentation ceremonies at Headquarters, Air Defense Command, Colorado Springs, Colo., on February 27, 1952.

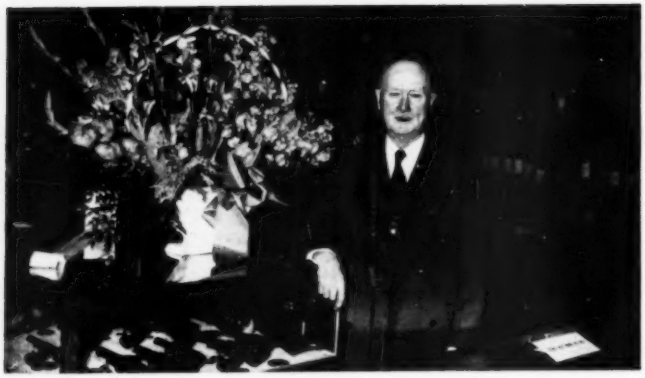
The presentation of the citation and a life membership in the Association was made by Louis Polk, member of the Board of Directors and a vice-president of the Association, and also president of the Sheffield Corporation of Dayton, Ohio.

"During his many years of service to this division of the Air Force, General Chidlaw gave inspiring leadership in the development of many new types of aircraft, their armament, and the myriad of allied matériel that add up to air power," the citation presented by Mr. Polk stated.

In making the award, Mr. Polk said that our present fighting strength in the air has depended, to a significant degree, upon the wise direction of General Chidlaw during the lean postwar years when he was commanding the Air Matériel Command.

"Today, as in the past, vigilance in ordnance is indispensable to defense," General Chidlaw declared in response to the citation. "Since its foundation in 1919, the American Ordnance Association has rendered an incalculable service to the security of America. I am deeply cognizant of the high honor you do me, and I am happy to be counted among the members of so distinguished an organization."

Louis Polk, right, vice-president of the A.O.A., presents citation and life membership to Gen. B. W. Chidlaw, Commanding General of the Air Defense Command.



Charles H. Coles, charter member of the American Ordnance Association, on March 1, 1952, completed 60 years of service with Colt's Manufacturing Company. He is a member of the A.O.A. Small Arms and Small Arms Ammunition Division.

General Chidlaw was graduated from the United States Military Academy at West Point in 1922. In the thirty intervening years he has worked constantly in the field of military aviation.

In early 1934 he helped inaugurate the Air Corps' flying of the air mail. Since the 1930's, General Chidlaw has been considered one of the foremost matériel authorities in the armed forces. Since August 25, 1951, he has been Commanding General of the Air Defense Command.

• **AT MIAMI BEACH.**—Approximately one hundred members of the Florida Post attended an industrial-preparedness dinner meeting on March 12th at the Surf Club, Miami Beach, Fla. The meeting was at the suggestion of Col. Charles G. Mettler who served as toastmaster. "P.D." Mettler has been a leader in Ordnance circles for many years. His friends in industry and in the military are legion.

Four speakers addressed the group. Lieut. Col. Antonio H. Manguso, representing Maj. Gen. William L. Richardson, spoke on the "Air Force Missile Test Center," the long-range proving ground at Banana River, Fla. Leo A. Codd, the Association's executive vice-president, spoke on the industrial-preparedness program of the Ordnance Association, while Col. H. R. Strom outlined the excellent combat record of American ordnance in Korea. The headquarters offices of the Post at Eglin Field were represented by a delegation of military and civilian officials.

Those at the speakers' table included Lieut Col. R. L. Dickson, Lieut. Col. A. B. Schwarzkopf, Col. Herbert A. Gidney, W. Arnold Hanger, Russell L. Heberling, Adm. Charles D. Loeffler, Col. Henry N. Marsh, Maj. Gen. Russell L. Maxwell, Charles E. Sorensen, and Robert L. Telford.

Colonel Mettler served as chairman of the local committee. Other members of the committee were Fred A. McMahon, George A. Corrigan, Earl E. Salisbury, Otto J. Doepel, James W. Dunaway, J. Dudley Murray, Walter J. Greachen, and Sam Luby.

Earlier in the season the Florida Post had a dinner meeting at the Shalimar Club, Shalimar, Fla. Lieut. Col. R. Frank Garner, Jr., Post president, presided and introduced Brig. Gen. Edward P. Mechling, Commanding General of the Research and Development Testing Ground at the Eglin Air Force Base.

Other guests at the dinner meeting were Hanson Baldwin, military analyst of *The New York Times;* Squadron Leader W. H. Newman of the Royal Air Force; Ralph L. Goetzenberger, vice-president of the Minneapolis-Honeywell Regulator Company, Washington, D. C.; Colonel Marsh, vice-president of the Hercules Powder Company, Wilmington, Del.; O. H. Winn of the General Electric Company, Syracuse, N. Y.; and Brig. Gen. Burton O. Lewis, the American Ordnance Association's staff consultant for Technical Divisions and Committees.

The principal speaker was Colonel Codd, Association executive vice-president.

On the following day, Post members and guests visited the climatic hangar and inspected various types of armament and instrumentation at Eglin Air Force Base.

• **AT BOSTON.**—The spring dinner meeting of the Yankee Post was held at the Hotel Somerset, Boston, Mass., on March 5, 1952.

The principal speaker was J. F. Wolfram, general manager of the Oldsmobile Division, General Motors Corporation, Lansing, Mich., who discussed the novel idea of dual-purpose plants as the best hope of guns and butter without industrial displacement or unemployment. The proposal for such plants as a permanent part of basic industries was first made by Charles E. Wilson, president of General Motors Corporation, at the national meeting of the American Ordnance Association in Cincinnati, Ohio, on March 4, 1951.

An added feature of the meeting was the showing of the official Air Force color film of the Air Force display of matériel at the Thirty-Third Annual Meeting of the Association at Wright-Patterson Air Force Base, Dayton, Ohio, on October 5, 1951.

The Post is publicizing the display room at Watertown Arsenal where copies of all current information, drawings of manufactured parts and part samples can be viewed by manufacturers. Col. B. S. Mesick is commanding officer at the arsenal. The room is operating under the direction of Ralph S. Towne, small-business specialist, who works directly under the Chief of Ordnance and has been assigned to Watertown Arsenal.

• **AT FORT WORTH.**—At the regular annual meeting of the board of directors of the Lone Star Post, held at Fort Worth, Tex., on January 24th, new officers for 1952 were elected. Warren W. Wells was appointed temporary chairman of the meeting.

The directors elected the following officers to serve for one year: C. E. Meilley, president; Mr. Wells, vice-president; and George W. Armstrong, Jr., national Council member.

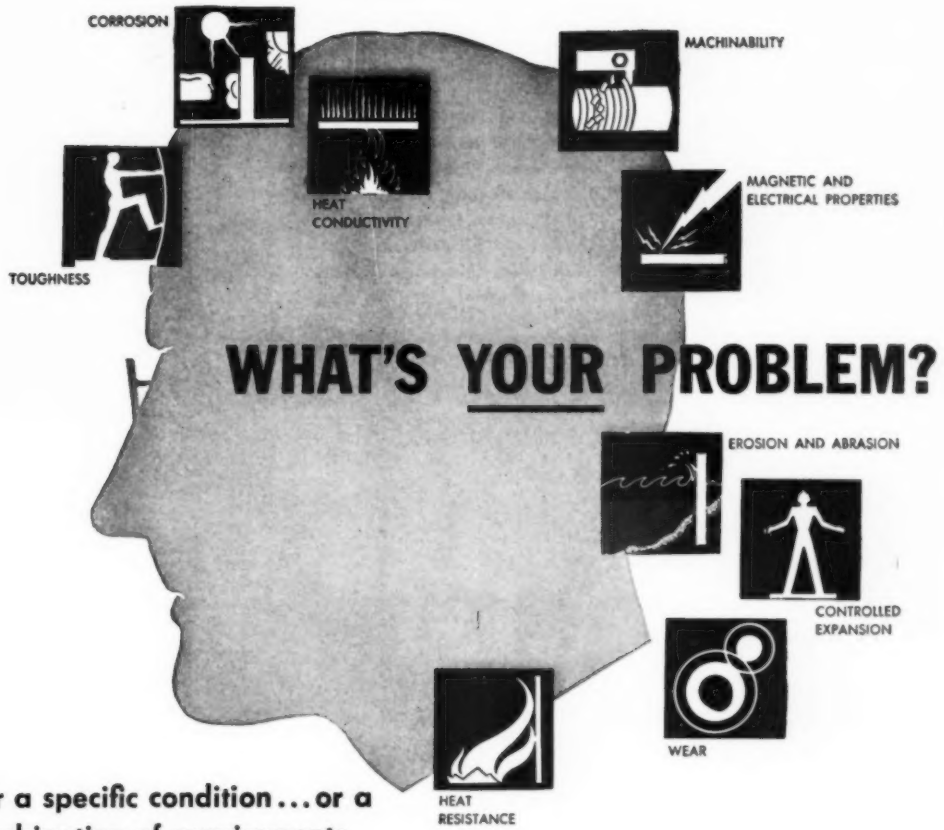
W. M. Harrison of Crown Machine Tool Company was unanimously elected secretary-treasurer. M. J. Neeley of Hobbs Manufacturing Company, was unanimously elected to fill a vacancy on the board of directors, succeeding F. A. Pierce. The retiring president, W. O. Beeman, was accorded a vote of thanks for his leadership of the Post during the past year.

• **AT HOUSTON.**—The Texas Post enjoyed an exceptionally good attendance at its meeting on January 29th at the Ellington Air Force Base.

The principal speaker was Robert L. Biggers, Association vice-president. Adm. A. K. Morehouse, commander of the Corpus Christi Naval Air Base, also addressed the meeting.

Post officials met with Maj. Gen. E. L. Ford, Chief of Army Ordnance, and members of his staff on February 5th at the Houston Country Club.

• **AT REXFORD, N. Y.**—The mid-season meeting of the Capital Cities Post was held at the Edison Club, Rexford, N. Y., on January 30, 1952.



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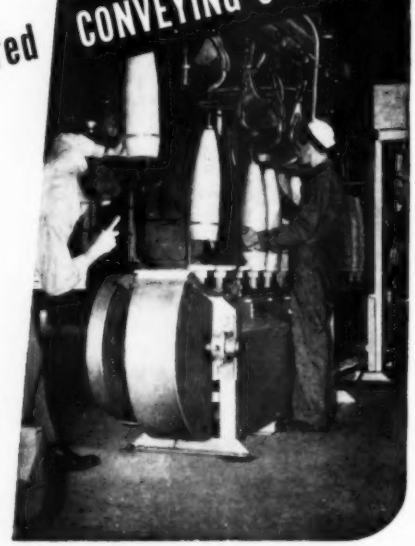

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Association Affairs

The meeting was initiated by one of the new Post directors, Ernest E. Johnson, manager of the General Engineering Laboratory, General Electric Company, Schenectady, N. Y., as a means to stimulate interest and action at the grass-roots level to do something about the critical shortage of technically trained personnel in the New York area and to attempt to establish a pattern for similar action by Association Posts and other agencies throughout the country.

The dinner meeting was preceded by a conducted tour and lectures in the new General Electric turbine shop. The tour afforded Post members and guests, many of whom were from educational agencies, excellent opportunity to see the latest developments in factory buildings, machines, processes, and electrical generating equipment.

In the absence of Post President Harry L. Erlicher on official duty in Washington, the meeting was presided over by the first vice-president, Col. Ledyard Cogswell, president of the Albany Lumber and Planing Mill Company, Albany, N. Y., for many years chief of the Rochester Ordnance District.

M. M. Boring, manager of the technical personnel division, General Electric Company, representing defense industry, acted as panel chairman.

Other panel members included Dr. Harry J. Linton, superintendent of public schools in Schenectady, who represented public education; Prof. A. A. K. Booth, department of mechanics, Rensselaer Polytechnic Institute, Troy, N. Y., who represented engineering colleges; and Nicholas I. Timeson, civilian personnel officer, Watervliet Arsenal, Watervliet, N. Y., who represented Army Ordnance.

After short introductory presentations by all panel members and a mutual exchange of ideas and suggestions, the meeting was thrown open to an extremely interesting question period.

• **AT EAST LANSING.**—A certificate of appreciation and the Patriotic Civilian Service Lapel Button were presented to Talbert Abrams, Lansing, Mich., in a special ceremony on February 4, 1952.

The award was presented on behalf of the Department of the Army by Col. R. G. Theiring of the Michigan State College R.O.T.C. Detachment. It was given to Mr. Abrams for his outstanding contributions and work with the Technical and Industrial Intelligence Committee, Joint Chiefs of Staff, during World War II.

Mr. Abrams, President of Abrams Aerial Survey Corporation and Abrams Instrument Corporation, is the designer and builder of the first airplane used for purely photographic purposes. This airplane is now on display in the National Air Museum of the Smithsonian Institution, Washington, D. C.

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Technical Service Data Sheet

Subject: IMPROVING PAINT ADHESION ON STEEL WITH GRANODINE®

INTRODUCTION

"Granodine" is a zinc phosphate coating chemical which improves paint adhesion on steel, iron and zinc surfaces. In the Granodizing process, a non-metallic crystalline coating is formed on the treated metal. This bond holds and protects the paint finish and thus preserves the metal underneath.

Official Dept. of Defense Photograph

An F4U Corsair with the Navy's new aircraft anti-tank rocket, the "RAM". A Grade I zinc phosphate finish (JAN-C-490) protects the entire external surface of this rocket and provides a durable bond for the specification paint finish.

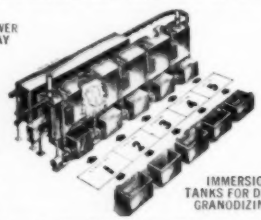
"GRANODINE" MEETS SERVICE SPECIFICATIONS

JAN-C-490, Grade I	CLEANING AND PREPARATION OF FERROUS METAL SURFACES FOR ORGANIC PROTECTIVE COATINGS
JAN-F-495	FINISHES FOR EQUIPMENT HARDWARE
U.S.A. 57-0-2C Type II, Class C	FINISHES, PROTECTIVE, FOR IRON AND STEEL PARTS
U.S.A. 51-70-1, Finish 22.02, Class C	PAINTING AND FINISHING OF FIRE CONTROL INSTRUMENTS; GENERAL SPECIFICATION FOR
MIL-V-3329	VEHICLES, COMBAT, SELF-PROPELLED AND TOWED; GENERAL REQUIREMENTS FOR

GRANODIZING DATA

Granodizing is an easily applied chemical process. Depending on the size, nature and volume of production, Granodizing can be carried out by spraying the parts in successive stages of a power washing machine, by dipping the work in the cleaning, rinsing and coating baths contained in tanks, or by brushing or flow coating the work with portable hand equipment. Typical process sequence and equipment requirements are shown below:

MULTI-STAGE POWER WASHER FOR SPRAY GRANODIZING



IMMERSION TANKS FOR DIP GRANODIZING

PROCESS SEQUENCE

1. Clean
2. Rinse
3. "Granodine"
4. Rinse
5. Final Rinse

NOTE: Equipment can be of mild steel throughout, except in the Granodizing stage, where nozzles, risers, and pump impeller should be of acid-resistant material.

MANY APPLICATIONS

Automobile bodies and sheet metal parts, refrigerators, washing machines, cabinets, etc.; projectiles, rockets, bombs, tanks, trucks, jeeps, containers for small arms, cartridge tanks, 5-gallon gasoline containers, vehicular sheet metal, steel drums and, in general, products constructed of cold-rolled steel in large and continuous production are typical of the many products whose paint finish is protected by "Granodine".

CHEMICALS ACP PROCESSES

WRITE FOR FURTHER INFORMATION ON "GRANODINE" AND YOUR OWN METAL PROTECTION PROBLEMS.

CHEMICALS ACP PROCESSES

He is also the inventor or manufacturer of many devices used in making aërial surveys and maps and is the donor of the Talbert Abrams Award which is presented annually by the American Society of Photogrammetry for outstanding achievements in that field.

• **MAJ. REUBEN E. GOHO**, a charter member of the Ordnance Association and a past president of the Yankee Post, died at Philadelphia on February 7, 1952. He was first commissioned in the Ordnance Department of the Army in June 1918. He served throughout the First World War and as a member of the Ordnance Reserve Corps until his service in World War II.

A native of Shenandoah, Pa., Major Goho was long identified with the Boston Ordnance District with which he served actively until 1922. Upon his return to civil life he resumed the presidency of the Boston Metal Ceiling and Manufacturing Company with which he had been identified since 1911.

He was recalled to service in the Ordnance Department in December 1941 and filled assignments of wide responsibility both in Washington and in Philadelphia. He was returned to inactive status in August 1945 and lived in Philadelphia until his death.

In addition to his active membership in the Ordnance Association, he was identified with the Military Order of the World War. He was a past president of the Rotary Club of Boston, a member of Philadelphia Rotary, and of the Charitable Mechanics Association of Boston.

A strong believer in ordnance preparedness, "Rube" Goho rendered especially noteworthy service during the 1920's and 1930's when his leadership was most helpful in counteracting the wave of popular indifference to national preparedness which characterized our country during that period. His services then and during both World Wars will be remembered gratefully by his many friends in the Ordnance fraternity.

• **DR. WILLIAM S. CALCOTT**, of Woodstown, N. J., special assistant to the director of the technical section of the Du Pont Company's organic chemicals department, died on February 15, 1952. A charter member of the American Ordnance Association, he was widely recognized as one of the Nation's leading research chemists.

Chief among the many research investigations carried out under Dr. Calcott's direction were indigo research, properties of materials for chemical-plant equipment, the development of methods of analysis for organic mixtures, and the development of a process for the manu-

JAN-P-116 Packaging and Packing for Overseas Shipment. Methods of Preservation, May 1945 and amendment No. 2 December 1948 (Demonstrating Method 1A-1)

READ AND SAVE THIS ISSUE FOR FUTURE REFERENCE

MILITARY PACKAGING SIMPLIFIED # 2 of a series

1. After connecting rod has been thoroughly cleaned and preservative applied, fill voids and pad ears with aluminum foil to prevent inclusion of moisture laden air.

2. Place connecting rod on sheet of aluminum foil (JAN-B-148) and wrap in usual way. Deadsoft properties of aluminum foil eliminate spring-back and speed production.

3. Completed foil greaseproof wrap. Note how foil may be molded to conform closely to odd-shaped object, thereby helping to keep preservative in contact with part.

4. Apply a Grade C Overwrap. Be sure a liberal size sheet is used to insure a perfect wrapping job. Fold wrap over the two ends of connecting rod first.

5. Continue Grade C Wrap by folding sides over, using "locked" folds where possible and sealing folds with sealer. If single dip method is used attach de-humidified dipping cord*.

6. Completed package after wax-dipping by single dip method. Label applied prior to dipping. If dipping compound is opaque label should be applied after dipping. Clip cord close to surface. Before packing apply non-blocking overwrap.

*The use of an aluminum dipping cord (⅛"-¼"—.004 gauge) has been approved by Army Ordnance and prevents "wicking" normally found in cloth cords.

ALUMINUM FOIL IS SUPERIOR AS A CONFORMING TYPE WRAP BECAUSE . . .

- ★ Aluminum foil is greaseproof on both sides.
- ★ Conforms tightly to any shape without taping or tying.
- ★ Easy to press out air that might contain moisture.
- ★ Non-absorptive; cannot wick off the preservative.

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FOR FLAMMABLE LIQUID, GAS AND ELECTRICAL FIRES

Ansul Low Temperature Dry Chemical Fire Extinguishers, Models LT-4-A and LT-20-A, have been tested and approved for operation at 65° F. below zero. These same extinguishers will withstand prolonged exposure to temperatures ranging up to +160° F. They are recommended for use where extreme temperature conditions prevail . . . where other types of fire extinguishers may be inoperative or ineffective.

MODEL LT-4-A ABOVE, CENTER MODEL LT-20-A

For flammable liquid fires, Ansul Dry Chemical Fire Extinguishers have the greatest fire-killing ratings ever attained by hand and wheeled portable fire extinguishers . . . Based on tests by nationally recognized approval agencies.

Ansul Wheeled and Stationary Extinguishers can be provided with special hose to allow operation at temperatures lower than −40° F.

NOTE THESE IMPORTANT ANSUL FEATURES . . .

- Patented nozzle provides most effective stream pattern.
- Easy, on-the-spot recharging. (No tools needed.)
- Low maintenance costs — no annual recharge necessary.
- Water-tight, corrosion-resistant construction.
- Safe to use on electrical fires.
- ANSUL *"PLUS-FIFTY"*® Dry Chemical is non-toxic, non-abrasive, non-corrosive.

Get the facts. See comparative effectiveness ratings for various types of approved fire extinguishers. Write for File No. 694. You will receive complete information and other valuable data.

ANSUL CHEMICAL COMPANY
Fire Extinguisher Division
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facture of tetraethyl lead. The latter, in which he collaborated with such prominent men as Thomas Midgely and Charles Kettering, proved to be one of his most outstanding contributions.

• **L. RAY BUCKENDALE,** vice-president in charge of engineering of the Timken-Detroit Axle Company, died on March 6, 1952.

Active for many years in the Michigan Post of the American Ordnance Association, he was a key figure in the field of truck engineering and had spent more than forty years in the development of modern truck axles.

Born in Detroit, Mr. Buckendale first became associated with the Timken-Detroit Axle Company in 1911. He was elected president of the Society of Automotive Engineers in 1946. He participated in many of the applications of axle development for use in military trucks and combat vehicles—a field in which his company, led by the late great Col. Herbert W. Alden, has pioneered.

• **PHIL HUBER,** chairman of the board of directors of the Ex-Cell-O Corporation, died at his home in Detroit on February 7, 1952. A valued member of the American Ordnance Association, he was one of the founders of his firm in 1919 and continued active in its affairs until the time of his death.

He was an especially active member of the Association's Michigan Post, having served as an official of that Post when it was inaugurated in 1942. Most notable in his long association with ordnance progress was the following incident which proved to be historic in more ways than one.

In the years before the Second World War the late Alex Dow, renowned engineer, presented to the Frankford Arsenal two ultramodern machines designed by Mr. Huber and produced by his company. The gift was made in an effort to install modern mass-production methods in Government arsenals. There were not sufficient funds available for the arsenal to purchase the machines so they were purchased by Mr. Dow with the cooperation of Mr. Huber.

Those machines—a patriotic gift—were the basis of undreamed-of progress in quantity production at the arsenal. Even more important, however, they were the beginning of a retooling program which saved countless lives in the Second World War. In those days the total appropriation for the operation of the entire Army Ordnance Department was less than eleven million dollars a year!

Valiant souls, Messrs. Dow and Huber, whose patriotism will long be remembered by their friends and associates!

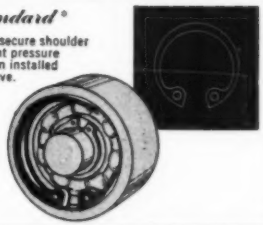
Speed Production, save material and machining operations with Waldes Truarc Retaining Rings

better way to hold parts together

THERE'S A TRUARC RING FOR EVERY PURPOSE

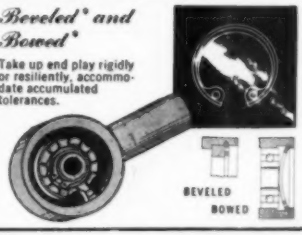
*Standard**

Forms secure shoulder for tight pressure fit when installed in groove.



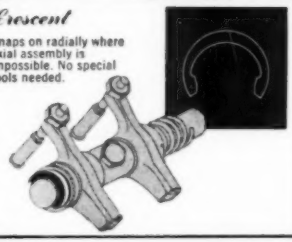
Beveled and Bowed**

Take up end play rigidly or resiliently, accommodate accumulated tolerances.



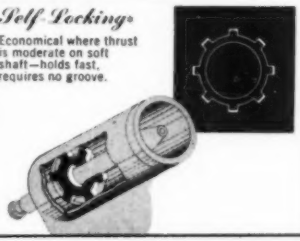
Crescent

Snaps on radially where axial assembly is impossible. No special tools needed.



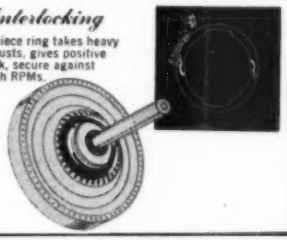
*Self-Locking**

Economical where thrust is moderate on soft shaft—holds fast, requires no groove.



Interlocking

2-piece ring takes heavy thrusts, gives positive lock, secure against high RPMs.

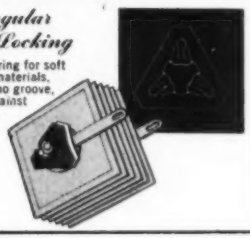


*Inverted**

Provides uniform shoulder for curved abutting surfaces, for bearings with large corner radii.

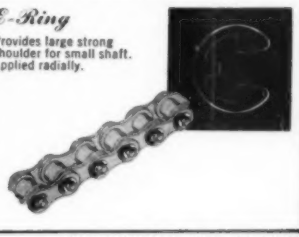
Triangular Self-Locking

Low cost ring for soft shafting materials, requires no groove, secure against vibration.



E-Ring

Provides large strong shoulder for small shaft. Applied radially.



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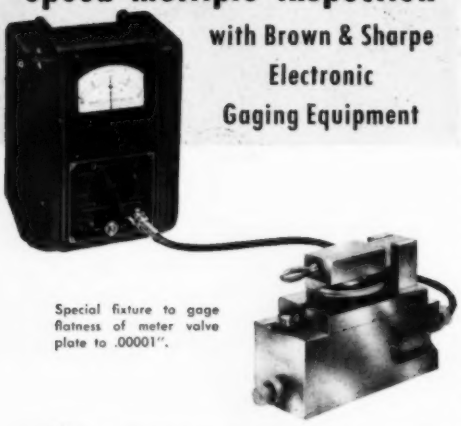
The same precision production facilities which have turned out millions of Truarc Rings to the most exacting specifications are available to handle sub-contracting of metal stampings. Write directly to Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N.Y.

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, N. Y. • MAKERS OF FAMOUS, PRECISION-ENGINEERED WALDES SLIDE FASTENERS AND SNAP FASTENERS

SPECIAL FIXTURES

speed multiple inspection

with Brown & Sharpe Electronic Gaging Equipment

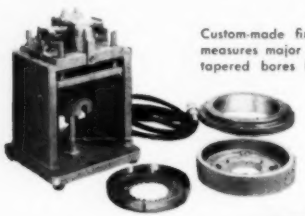


Special fixture to gage flatness of meter valve plate to .00001".

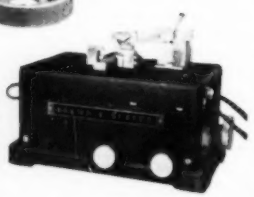
HERE'S how you can get faster, more accurate gaging for many kinds of small parts. Special gaging fixtures, custom-built by Brown & Sharpe, check all critical dimensions by .0001" to .00001".

Employing versatile Brown & Sharpe Gage Head Cartridges, these low-cost fixtures in combination with Brown & Sharpe Electronic Amplifiers provide flexibility that enables gaging right at the machine. Measurements are visually magnified from 1800 to 18,000 times.

Investigate Brown & Sharpe Electronic Gaging Equipment for your quality control. It can be applied for gaging thickness, length, angle, parallelism, diameter, taper or combinations of several dimensions. For details, write Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.



Custom-made fixture simultaneously measures major and minor I.D.'s of tapered bores for taper accuracy.



Special fixture checks dimensions, side squareness, and side parellelism of cutter blades.

We urge buying through the Distributor

BROWN & SHARPE

New DEVELOPMENTS

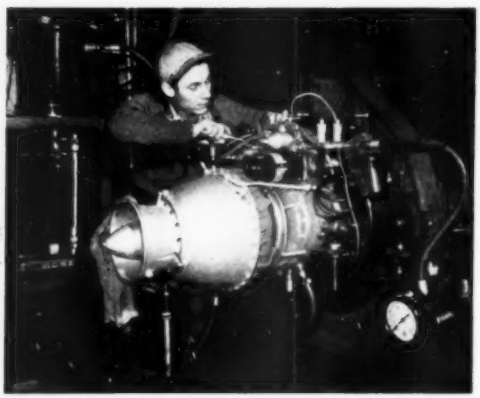
GRENADES ON GARANDS

John C. Garand, inventor of the famous Garand rifle carried by millions of Americans in World War II and in Korea, received patent number 2,587,611 for improvements in a valve mechanism on the rifle to be operated when a grenade launcher assembly is attached to the rifle. He assigned his patent to the Government.

In launching a grenade with a rifle the gases in the barrel build up a great deal of pressure. The purpose of the valve is to relieve that pressure and thus save the recoil mechanism of the rifle from excess wear. The valve is opened by force when the grenade launcher is attached to the rifle, but it cannot be jarred open when the launcher is not in use. The valve also closes readily after the launcher is removed.

BABY GAS TURBINE

A small French-built gas turbine, the Oredon, is being modified by the Stratos Division of the Fairchild Engine and Airplane Corporation to fit American requirements and will be produced in the U. S. under a license from the French engine company, Société Turbomeca. Rated at 140 shaft horsepower for continuous operation and 160 shaft horsepower for operation at short intervals, the unit is intended to power accessories.



The French Oredon gas turbine engine.

The Oredon is particularly well suited for operating alternators since its speed-control system holds r.p.m. within plus or minus 0.4 per cent. Compact and light, the unit measures only 31.7 inches over all and 20.5 inches in diameter. Its weight is 185 pounds. Specific fuel consumption is low for a unit of its size, being only 1.04 pounds per shaft horsepower per hour.

ARMY AIDS TB FIGHT

The Army Ordnance Corps is voluntarily deferring deliveries of a chemical compound called hydrazine, being experimented with as a rocket propellant, so that more of it may be used to produce new drugs which have brought dramatic improvement in tuberculosis patients.

Until 1946, no volume production of hydrazine had been required or undertaken. At that time hydrazine showed

Planning together

As production hits its stride, more and more joint planning is required between the military man and the businessman, to produce essentials for *both* industrial *and* defense needs.

To help meet this challenge, American Locomotive carries on two separate operations.

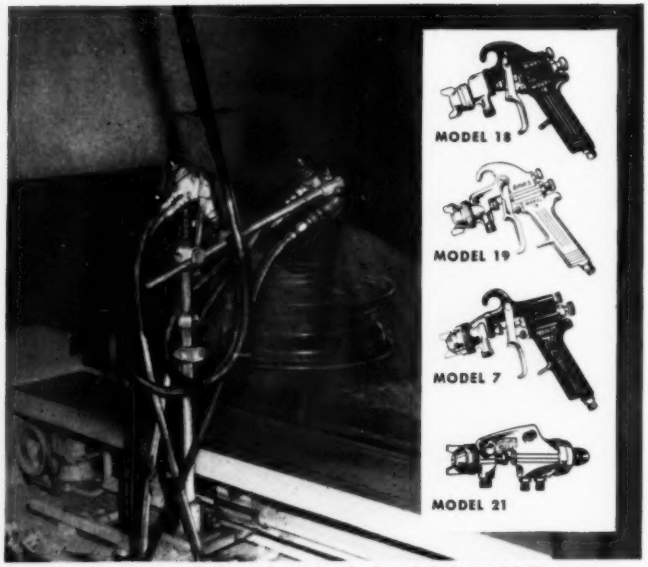
From one group of Alco plants come *basic industrial products* . . . diesel-electric locomotives for railroads . . . process equipment for chemical and petroleum producers . . . springs, diesel engines, and a host of similar products for other industries.

From other Alco plants comes *military* equipment . . . the Army's new medium tank . . . jet containers for the Air Force . . . nickel-plated pipe for the A.E.C. . . . other defense products for all the armed forces.

It is this *dual* production for both defense and industry that helps keep America prepared.

AMERICAN LOCOMOTIVE COMPANY

producing both industrial and defense products



Set-up for the automatic finishing of vehicle wheels with Binks Model 21 spray guns. Guns cut off automatically between units and do not spray when empty spindle passes.

SPRAY GUNS for every finishing need

Maybe your job involves a special finish or coating for military equipment...or finishing wood and/or metal surfaces on a fast schedule... or coating with flock. Whatever the need, if it involves spraying, Binks has a gun for it...more than 36 models with some 1050 nozzle combinations. Here are the four leaders:

Model 18—a precision gun for applying the finest finishes at the lowest cost. Finest gun in the line.

Model 7—a heavy-duty production gun. This is a long-time favorite.

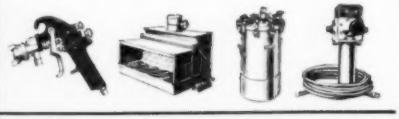
Model 19—a remarkable lightweight production spray gun, using the same nozzles as Model 18. A favorite with women operators.

Model 21—a heavy-duty gun for automatic spray finishing of revolving objects. Other automatic guns are available for finishing of such flat surfaces as table tops, hides, etc.

Hiring or training spray gun operators?
Send for this FREE booklet of painting tips!

Here's a pocket-size guide to overcoming common troubles in spraying. Trouble and remedy are described in simple, easy-to-absorb words. An invaluable aid to foremen, supervisors, instructors in industry, government, armed forces, etc. As many copies as you need, FREE. Write, on your business letterhead please, for "SPRAY PAINTING HINTS." Address: Binks Manufacturing Co., 3122-30 Carroll Avenue, Chicago 12, Ill.

Binks
EVERYTHING FOR SPRAY PAINTING



GUNS • SPRAY BOOTHS • MATERIAL TANKS • EXTRACTORS & ACCESSORIES

REPRESENTATIVES IN PRINCIPAL U. S. & CANADIAN CITIES • SEE YOUR CLASSIFIED DIRECTORY

New Developments

promise as an improved rocket propellant. Army Ordnance sponsored large-scale manufacture of the compound, and a production base for the vital material thus was established.

Medical researchers experimenting with the new drugs have pointed out that clinical tests are as far advanced at this time only because Army Ordnance sponsored volume production of hydrazine for its research program. The voluntary release of additional quantities of the compound into commercial channels will assure continuation of these tests.

MISSILE PHOTOGRAPHY

A technique to test the flight of the Navy's newest projectiles has been developed for use in the Aëroballistics Laboratory, China Lake, Calif. Known as multiple-image silhouette photography, this technique permits the accurate and economical measurement of deviation of a missile in flight. The missile is photographed six times on a single photographic plate by means of successive light flashes of microsecond duration (known as "stroboscopic"). Thus, an accurate determination of the aërodynamic and ballistic characteristics of the missile can be made.

JET HELICOPTER

A helicopter powered by small jet engines, designed so that it can be dropped from larger planes, unpacked by two men, and put in the air in approximately twenty minutes, is being developed under sponsorship of the Army Ordnance Corps. The new aircraft is designed for air evacuation, transport, and supply as well as for observation. The lightest and smallest aircraft being developed for the Army, it weighs less than 300 pounds, is 6 feet high, and can be collapsed into a container 5 by 5 by 14 feet. Designated the XH-26, the aircraft is basically a one-man ship powered by two 16-pound pulse-jet engines, one on each end of the rotor blades. Top speed of the XH-26, being developed by the American Helicopter Company of Los Angeles, Calif., is eighty miles an hour.

FEATHERS REPLACE WOOL

Chicken feathers, produced in enormous quantities in the United States and heretofore regarded largely as waste material, will be converted into a valuable commodity for keeping servicemen warm in winter campaigns as a result of a new Army Quartermaster Corps development.

With the coöperation of industry, methods have been devised for the extraction of usable small feathers, for treating the feathers to remove odors and retain natural resiliency.

Savings of tremendous quantities of wool are expected to result from the use

KNOW-HOW IS IMPORTANT!

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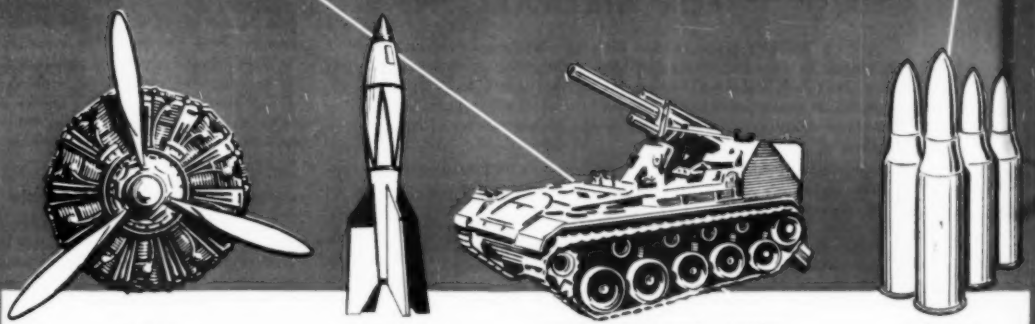
Greatly Increased Today, and Ready for Far Greater Demands Tomorrow!



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WHEELS, BRAKES, HUBS and DRUMS FOR ALL MILITARY VEHICLES

SHELLS and SHELL CASINGS

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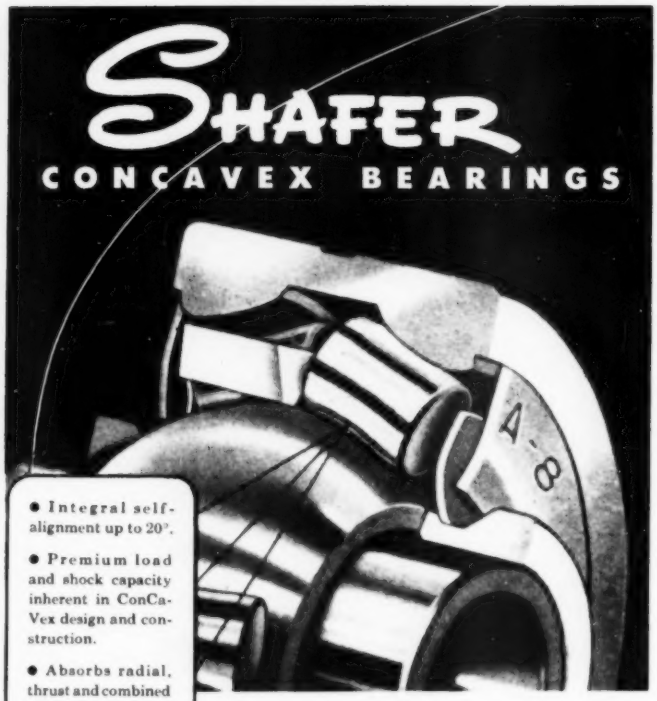
7 GREAT PLANTS: McKeesport, Pa.; 2 Plants in Detroit; Jackson, Mich.; Davenport, Iowa; Los Angeles, Calif.; Windsor, Ont., Canada



- Integral self-alignment up to 20°.
- Premium load and shock capacity inherent in ConCa-Vex design and construction.
- Absorbs radial, thrust and combined loads.

THE LIGHTWEIGHT
HEAVYWEIGHTS
FOR AIRCRAFT....

Shafer Bearings have long been waiting for aircraft demands to approach their ability for absorbing tremendous overloads and shocks. This explains the aircraft industry's steadily growing trend to "Shaferize" the vital control mechanisms of every type of air-borne craft—both commercial and military.

The basic ConCaVex design is an aircraft "natural." It provides high load and shock capacity, low friction and integral self-alignment together with space-saving, weight-saving compactness. This, combined with advanced engineering, precision craftsmanship and finest materials have, for 32 years, ranked Shafers as the No. 1 choice in aircraft control bearings.

Compare them. Test them. You'll find they surpass YOUR every expectation just as they surpass every rigid Army and Navy specification. Write for aircraft Bearing Catalog No. 50.

SHAFER BEARING CORPORATION
801 Burlington Ave. • Downers Grove, Illinois

Single Row, Double Row and Rod End, Self-Aligning, Shielded, Aircraft Roller Bearings

The best in Industrial Bearings, too! Write for new Catalog No. 51.

New Developments

of processed chicken feathers as insulation material in a newly designed combination sleeping bag and comforter which will replace the present Army wool sleeping bag. The wool bag requires a water-repellent cover when used out of doors. The new chicken-feather-insulated bag has no wool in its construction. Its outer cotton cover is wind-resistant and water repellent. Tests show that it affords twice the warmth of a wool bag.

NEW NAVY JET

The Navy Bureau of Aëronautics has announced the completion of initial tests on a new and more powerful jet engine to power its latest fighter aircraft. The engine is an advanced version of the J-48 Turbo-Wasp built by Pratt & Whitney Aircraft in East Hartford, Conn. The new J-48 passed its preflight tests and is scheduled for immediate flight test. It will be in production this fall.

This latest version of the J-48 uses a new heat-resistant alloy which contributes materially to increased performance and saves substantially on critical metals now in short supply. The engine delivers a great deal more thrust than the previous J-48 model which is rated at 6,250 pounds' static thrust.

AUTOMATIC PARACHUTE

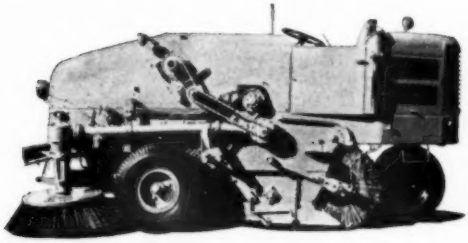
A new lightweight, automatic-opening parachute developed by the Air Research and Development Command, Dayton, Ohio, weighs only twenty-two pounds—twenty per cent less than present chutes—can be opened manually or by use of automatic opening equipment preset to open at a specified altitude and within a specified time. The new chute is designed to lower opening shock and reduce oscillation frequently experienced in descent. The harness is a simplified system of nylon straps, with only three adjustments as compared with seven for chutes now in use.

COMBAT CONTACT LENSES

The Army Medical Research Laboratory at Fort Knox, Ky., is conducting tests to determine whether contact lenses will enable riflemen, tank drivers, gunners, and other fighting soldiers to lay aside hazardous, old-style spectacles while in combat. Experience during World War II and in Korea has shown that glasses are easily broken or lost under field conditions. Reflection sometimes makes the wearer an attractive target for small-arms fire.

BORE-HOLE CAMERA

A bore-hole camera to photograph rock strata is being tested by the Army Corps of Engineers. In its present stage, it can take 360-degree pictures of a 3-inch-diameter bore hole. During the next year,



How heavy-pitch Morse Chains answer this sweeping challenge

Fleets of Wayne Pick-Up Sweepers are used by the Navy, Army, and Air Force and by over 200 cities (New York alone using 71) to make streets sparkling clean for pennies per mile. In model shown above, hopper capacity is over 84 cubic feet of sweeper-moistened dirt and litter, which sweeper carries at truck speed to central dumping ground. The work is punishing, but this quality-built machine stands up to it.

Power transmission

Heavy-pitch Morse Roller Chains transmit power from four-speed transmission to front wheels. Other Morse Chains drive street-to-hopper dirt conveyor and rear pickup broom, supply power to forward gutter broom.

The Morse Chains operate with 99% efficiency on both long and short centers. They give long, efficient life; require minimum of service. Morse Chains contribute materially to the Wayne Sweeper's reputation for exceptional performance at low operating cost.

If you are faced with unsolved power transmission problems, look into the reliability, economy and efficiency of Morse Roller Chain Drives. Or perhaps your need is for some other power transmission product in the famous Morse line of clutches, flexible couplings, drive shafts, silent chains, double-pitch roller chains, or cable chains. Let us send you information on the application you have in mind.

M = PT Morse *means* Power Transmission

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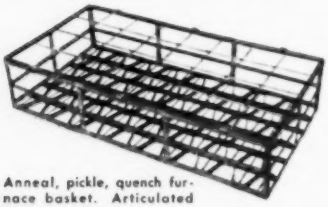
MORSE
MECHANICAL
POWER TRANSMISSION
PRODUCTS

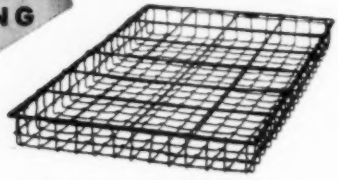
ROLOCK
FABRICATED ALLOYS



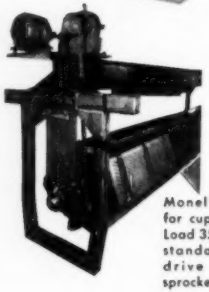
Anneal, pickle, quench furnace basket. Articulated "Serpentine" grid, (pat. applied for), removable work dividers. Wt. 70 lbs., load 330 . . . ratio about 5 to 1.

Pit type furnace basket for heat treating shell cases. Two layers of shells, mesh separator. Basket has loose shell, easily replaced. Fabricated grid, long life.

MINIMIZE REJECTS
CUT COSTS
IN ORDNANCE HEAT TREATING . . PICKLING



Lock-crimp, woven wire shell case basket, flat bottom, travels on rolls, either direction. Anneal and pickle. Wt. 54 lbs., load 350 lbs., ratio 6½ to 1.



Monel pickling barrel for cupped steel parts. Load 3500 lbs. Low H.P. standard speed motor drive thru bronze sprocket and chain.

Monel pickling rack designed for 2000 lb. load in 8% H_2SO_4 at 165° F. Wt. 500 lbs., ratio 4 to 1.

New Catalog shows many exclusive designs produced for leading metal working plants. Copy on request.

Offices in: PHILADELPHIA • CLEVELAND • DETROIT • HOUSTON • INDIANAPOLIS • CHICAGO • ST. LOUIS • LOS ANGELES • MINNEAPOLIS

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JOB-ENGINEERED for better work
Easier Operation, Lower Cost

SRLB2

New Developments

further tests are expected to improve not only the camera's performance but also its accompanying projection equipment.

The camera, cylindrical in form, can be lowered into a bore hole and operated electrically by means of a cable. Either dry or water holes can be photographed with equally good results. By use of a specially designed projector, the pictures can be viewed in undistorted form on a cylindrical screen.

NIGHT FLYING GLASSES

For aging pilots whose vision isn't as sharp as it used to be, a new type of spectacles for night flying is being perfected at the Air Force School of Aviation Medicine, Randolph Field, Tex. They cannot make a normal eye see better in the dark, but the new lenses, coated with magnesium fluoride, will make night operations safer and save for the Air Force the valuable experience of its older pilots.

QUARTZ INSULATION

Quartz paper developed by the Naval Research Laboratory can be manufactured cheaply from abundant domestic sources, may be substituted for higher-cost asbestos insulation material, and withstands temperatures up to 3,000 degrees Fahrenheit as compared with 1,000 degrees for asbestos. Since quartz paper is boron-free, it may be used as insulation in components subject to atomic radiation and in nuclear-energy power plants. Manufacture of quartz paper closely resembles conventional papermaking. In a recent test run with a Fourdrinier papermaking machine, paper five-thousandths of an inch thick was produced at a speed of forty feet a minute.

NEW BOOT PROTECTION

A new synthetic-rubber insulation, designed to replace wool fleece and felt in combat boots, is being tested by the Quartermaster Corps. Present insulation is sealed between two rubber layers, and readily absorbs moisture if either is punctured, thus requiring prompt patching of any holes. Use of unicellular synthetic rubber is expected to make the boot more resistant to puncture. It is water-resistant and makes immediate patching unnecessary if the boot is torn. The new insulation is still in the experimental stage and will not be standardized for general issue until field testing is completed.

RADIATION DETECTOR

A scintillation detector designed by the Naval Research Laboratory to detect high-intensity nuclear radiation with good time resolution, is capable of giving a

The Men Behind "The Men Behind the Guns"

Among the most urgent necessities of our national security program is steel . . . cast and fabricated for combat and used in a thousand other ways. Men at Blaw-Knox work around the clock to supply material and equipment so urgently needed by our armed forces . . . for fighting, for protection, for transport, for the many other functions of the nation's preparedness program.

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- ★ Rolls for Steel & Non-Ferrous Mills
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- ★ Complete Chemical & Industrial Plants
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- ★ Steel Forms for Concrete Construction
- ★ Contractors Equipment
- ★ Clamshell Buckets
- ★ Engineering Service

RECENT CATALOGS AND BULLETINS detailing practically all Blaw-Knox products are available, and any literature you request will be forwarded by return mail.

Rockwell Report

by **W. F. ROCKWELL, JR.**
President
Rockwell Manufacturing Company

IN THE LAST TEN YEARS, like many another company, we have had to turn handsprings to get out some badly needed material for a critical construction project. One such was the Plantation Pipe Line, carrying vital petroleum products across the south, for which we built Nordstrom valves. Here is a paragraph from a letter from Charles R. Younts, President of the Company:

> *"We could not have maintained our schedule if it had not been for the assistance of just such folks as you and your good company, who supplied us the necessary materials . . . we have asked you to do the impossible and you have accomplished that; and so, we have elected you to be a member of our exclusive club in Plantation called the 'Impossible Club'."*

* * *

Sven Nordstrom, the inventor of the Nordstrom valve died recently. His story is a typical American success story and certainly one that has contributed mightily to the growth of our company.

Nordstrom was a mining engineer and about thirty-five years ago he combined the scientific principle of Pascal's Law with simple, centuries-old plug cock to make the first successful lubricated plug valve.

He intended it for use in the mining industry, but today this valve is specified as standard equipment in hundreds of gas and petroleum services.

Each year, however, the market broadens as Nordstrom valves are installed in new processes and technologies. Here are some examples:

Paint, brine, chlorine, propylene glycol, calcium hypochlorite, ethylene cyanohydrin, sewage sludge, asphalt, acetic acid, alum, zinc chloride, vegetable oils, turpentine, sulphuric acid, styrene, sodium bicarbonate, pitch, wood pulp, oxygen, nitrogen, lye, steam, iodine, hydrogen peroxide, helium, gypsum, soap, glue, glycerine, fruit juices, furfural, flavoring extracts, epsom salts, creosote, carbonated beverages, blood plasma, beer, and animal oils.

Though this list is far from complete, it indicates the extreme versatility of Nordstrom valves. You'll notice, too, that many of the substances are of a type that cannot be held by ordinary valves.

Both the product and the man grew with and caused our organization to grow. The Nordstrom valve is one of our main line products. Sven Nordstrom served on our Board of Directors until his death, and his loss will be felt severely.

* * *

During 1951 we made 72 major executive promotions, all directly traceable to the company's growth. In only three cases was it necessary to go outside the organization to find supervisory people qualified to fill the job.

* * *

One of the newer products of our Delta Power Tool Division is an air-powered hydraulic drill head. It can be adapted to almost any mass production special drilling job with spectacular savings. For instance, Milwaukee Flush Valve Company has a setup that hollow mills, drills, reams, spot faces, counterbores, faces, countersinks, threads and taps from a single setup with a production increase from the former rate of 52 pieces per hour to 215 pieces per hour.

One of a series of informal reports on the operations and growth of the
ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8, PA.
for its customers, suppliers, employees, stockholders and other friends

New Developments

20-ampere (peak value) pulse of 10 microseconds' duration at an operating voltage of about 6,000 volts. The detector consists of a large coaxial phototube with an opaque photocathode as center conductor and mesh-type anode as outer conductor.

PORTABLE TELEPHONE

A new and improved portable field telephone set has been developed by Bell Telephone Laboratories. The new set is lighter in weight, smaller, and rugged

The new field telephone.

enough to survive parachute drops with ease. In an emergency the set operates efficiently for several miles without batteries on voice power alone.

The handset is shaved at the earpiece end so it can fit beneath a battle helmet with comfort; the mouthpiece, or transmitter, stands up nicely to near-by gun blast; and the entire set works effectively at 40 degrees below zero or in the heat of 130 degrees and at altitudes up to 50,000 feet. It can be dunked in water without effect as the entire set is waterproofed by a series of gasket seals. Moreover, it can be operated by a soldier wearing long, heavy arctic mitts.

PRIMAQUINE TESTS

Primaquine, the new antimalarial drug used in field tests in Korea, will be tested on 1,000 Army volunteers in this country. Primaquine has been administered to all troops returning from Korea since December 1951. The thousand men selected for these tests were exposed to malaria in Korea, returned to the U. S. before that time, and did not receive primaquine. Observations of test subjects will continue until October 1952, as summer months are considered a critical period for malaria relapses among those previously exposed.

LONG-LIFE TUBES

Thirty new long-life electron tubes for military use have been produced under

FLUID HEAT'S ENGINEERS
can solve these problems for you!

PERHAPS the answer to *your* heating problem lies in one of Fluid Heat's production units . . . or in a slightly modified model. On the other hand, your requirements may necessitate a complete new design and development project. In either case, Anchor's experience is at your command.

For over twenty-five years the Fluid Heat Division of Anchor Post Products, Inc., has been designing and building heating equipment . . . heating equipment to fill particular requirements . . . heating equipment designed and developed from start to finish in Anchor's own laboratories.

Anchor's engineering know-how has produced compact, independently operated heaters for personnel heating that faithfully put forth from 15,000 to 100,000 B.T.U.'s per hour on a minimum of gasoline, kerosene, diesel oil or fuel oil. This same know-how has produced the famous Fluid Heat Coolant Heater that gives instant starts under the most trying atmospheric conditions and temperatures down to 65° below zero.

Currently in production, for example, is heating equipment aimed to keep America's mobile military equipment and personnel ready for action regardless of weather . . . heating equipment that meets all the rugged requirements of the Armed Forces' latest specifications.

To find out how Anchor can help you solve your heating problems, write or phone the Fluid Heat Division, Engineering and Design Section. Specifications, data, and above all, *experience*, are yours for the asking!

fluid heat
PRODUCTS

DIVISION OF ANCHOR POST PRODUCTS, INC.
6805 Eastern Ave., Baltimore 24, Md.
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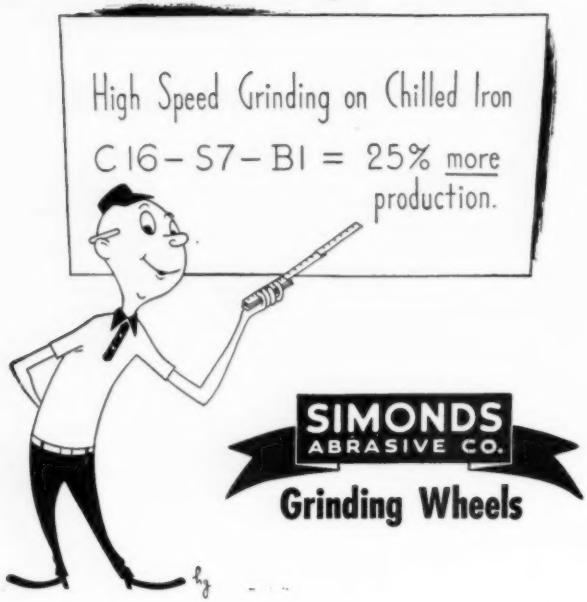
Here's how the Grinding Department figures it...



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Division of Simonds Saw and Steel Co., Fitchburg, Mass. Other Simonds Companies: Simonds Steel Mills, Lockport, N. Y., Simonds Canada Saw Co., Ltd., Montreal, Que. and Simonds Canada Abrasive Co., Ltd., Arvida, Que.

New Developments

a Navy Bureau of Ships project in cooperation with the Army and Air Force. The new tubes are of a standard type and can be used commercially as well as in military equipment.

Guided by the Department of Defense Research and Development Board, the program has produced electron tubes which have proved from two to ten times more resistant to shock and vibration and have twenty times the life expectancy of former types.

AERIAL SURVEY

A new rapid surveying method which has been successfully tested by the Engineer Research and Development Laboratory, Fort Belvoir, Va., utilizes airborne stations to eliminate time-consuming conventional ground survey methods. "Flare triangulation" depends on a plane fitted with signal lights and flares and ground parties whose theodolites are equipped with cameras to record instrument readings at any desired instant while tracking the airborne flare. Simultaneous readings from all stations, some at known locations, others at unknown locations, are made by tripping camera shutters by remote control from the plane. Trigonometric computations based on known stations are extended to locate unknown stations.

"SOFAR"

The Navy has acquired basic patent rights to SOFAR (sound fixing and ranging), a development which allows underwater sounds to be picked up more than 3,000 miles away. The Bureau of Ships said that SOFAR may be adopted for search and rescue operations.

If SOFAR is adopted for search and rescue work, life rafts and aircraft will be equipped with small bombs. Dropped overboard, these bombs will sink to proper water depths and explode. Sound waves thus released will be picked up by Navy SOFAR stations and positions of craft determined by triangulation.

PAPER THERMOMETERS

Thermal indicators made of paper and capable of determining temperatures ranging from 115 to 500 degrees Fahrenheit have been developed by the Army Quartermaster Corps. Although these paper thermometers were designed initially to ascertain the thermal radiation of atomic blasts, they probably will also be used in testing the performance of gasoline engines, motors, heaters, and other appliances.

The thermometers are inexpensive, readily disposable, and said to be thoroughly reliable. They consist of white pigment coatings on black paper. Each

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Every Underwood feature contributes something really *important* to your quiet efficiency:

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. . . to get the work . . . and *you* . . . out on time!

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UNDERWOOD

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. . . made by the Typewriter Leader of the World

New Developments

coating is designed to melt at a given temperature. When one of the indicators is heated to its designated temperature, the white coating melts and disappears into the black porous paper, revealing the black background.

HUMIDITY "WATCHDOG"

A new electronic development that makes possible a more accurate means of safeguarding packaged military equipment from rust and corrosion during long storage periods has been announced by the Minneapolis-Honeywell Regulator Company. The device is a small, highly sensitive relative-humidity indicator that is sealed inside vaporproof containers when the equipment is stored and acts as a "sentinel" to warn of excessive humidity. The moisture content of the sealed package at any given time can be determined easily and quickly by plugging a small, portable electron meter into an outside connection and reading directly from it.

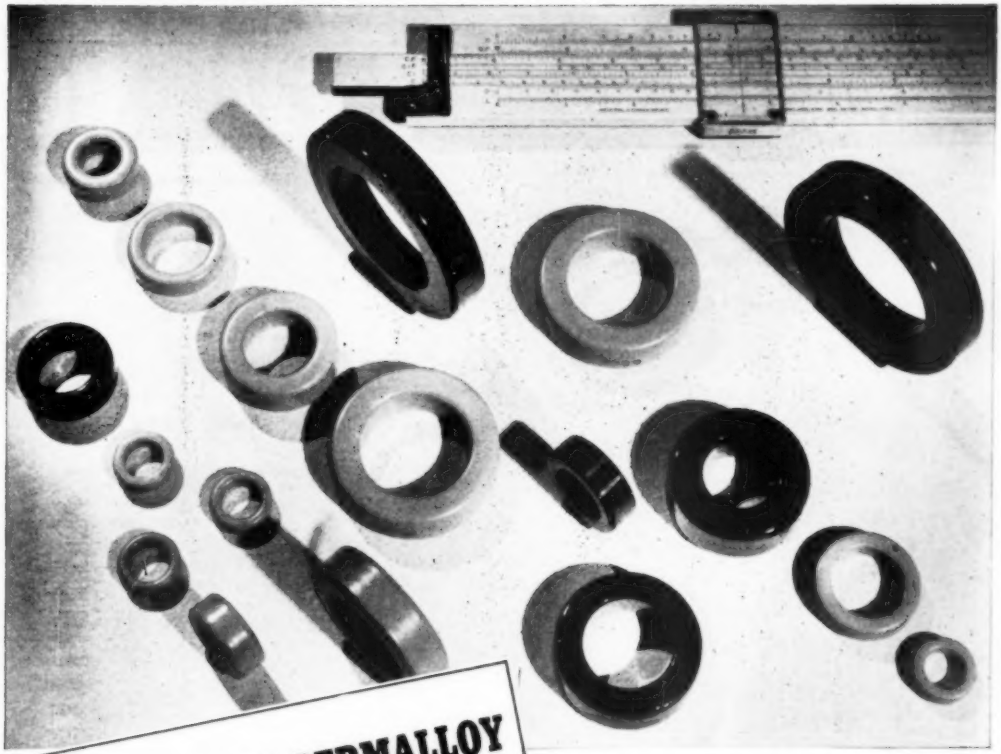
Heart of the system is a tiny sensing element, about the size of a matchbook cover. It is made of plastic and embossed on one side with a gold-leaf grid. This grid is coated with a hygroscopic film that changes in conductivity with changes in relative humidity. The element is so sensitive it can measure the presence of half a tablespoon of water in a room twelve by eighteen feet in size.

DURALUMIN PROTECTION

Development of a process for the nickel coating of aluminum, which may find many applications in industrial manufacturing, was announced recently. The new process solves a major problem in the coating of aluminum with nickel to give a stress-free, hard, yet resilient coating. A synthetic rubber compound is used to establish a bond, previously unattainable, between the aluminum and nickel plate. The process is of major importance in protecting duralumin propeller blades from the pitting and eroding effect of spray thrown up in sea landings and take-offs.

HERMETICALLY SEALED RELAY

A new general-purpose, hermetically sealed relay for use in aircraft, shipboard, and portable land-based electrical systems and electronic equipment has been developed recently. The relay, designed to meet or better provisions of Joint Military Service Specifications for Relays (MIL-R-6106), resists all harmful atmospheric conditions, including salt spray, high humidity, sand, fungi, and widely varying air pressures, and offers increased reliability and from two to six times longer life than existing equipment.



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(New technical data now available)

HIGH Q TOROIDS for use in Loading Coils, Filters, Broadband Carrier Systems and Networks—for frequencies up to 200 KC

COMPLETE LINE OF CORES TO MEET YOUR NEEDS

- ★ **Furnished in four standard permeabilities—125, 60, 26 and 14.**
- ★ **Available in a wide range of sizes to obtain nominal inductances as high as 281 mh/1000 turns.**
- ★ **These toroidal cores are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.**

For high Q in a small volume, characterized by low eddy current and hysteresis losses, ARNOLD Moly Permalloy Powder Toroidal Cores are commercially available to meet high standards of physical and electrical requirements. They provide constant permeability over a wide range of flux density. The 125 Mu cores are recommended for use up to 15 kc, 60 Mu at 10 to 50 kc, 26 Mu at 30 to 75 kc, and 14 Mu at 50 to 200 kc. Many of these cores may be furnished stabilized to provide constant permeability (±0.1%) over a specific temperature range.

Manufactured under license arrangements with Western Electric Company

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PAGE Welding Electrodes

ORDNANCE IN REVIEW

Since "what is past is prologue" we have thumbed through the musty back files of this magazine to discover what the armament picture was in earlier years and how subsequent developments have changed that picture.—THE EDITORS.

Thirty Years Ago

AIRCRAFT ARMAMENT

When the advance in development of aircraft permitted the carrying of armor and the use of metal bracings and coverings, it was found that even the armor-piercing ammunition of the caliber .30 aircraft machine gun was being reduced in effectiveness. It lacked the power always to pierce the armor, and if it passed through a metal strut or brace in the structure of the airplane it would not weaken it to the breaking point.

This naturally pointed to the need for a larger caliber gun. It was recognized that such a gun must be mounted in pursuit airplanes on which air supremacy depended, but since these rapid single-seater fighters which had to climb to great altitudes could not carry very heavy weights, the caliber of the gun which could be used was limited. The 11-mm. gun developed for attacking balloons and dirigibles was not powerful enough, but it was felt that if a gun of this size could be designed to give higher velocities, it would be just the weapon required.

The development of such a gun was undertaken, but a satisfactory one was not produced during the war. Initial satisfactory tests of a caliber .50 aircraft machine gun have recently been held in this country, and there is every indication that this super machine gun will be used on all aircraft in future battles in the air. —*From "Aircraft Guns," by William A. Borden, published in the May-June 1922 issue of* ARMY ORDNANCE.

The caliber .50 gun was subsequently developed by Ordnance and was the main source of our aërial firepower in World War II. It is still our principal aircraft weapon, although a caliber .60 machine gun and 20-, 37-, and even 75-mm. aircraft cannon have been employed in our planes. Modern jet speeds, however, indicate the need for

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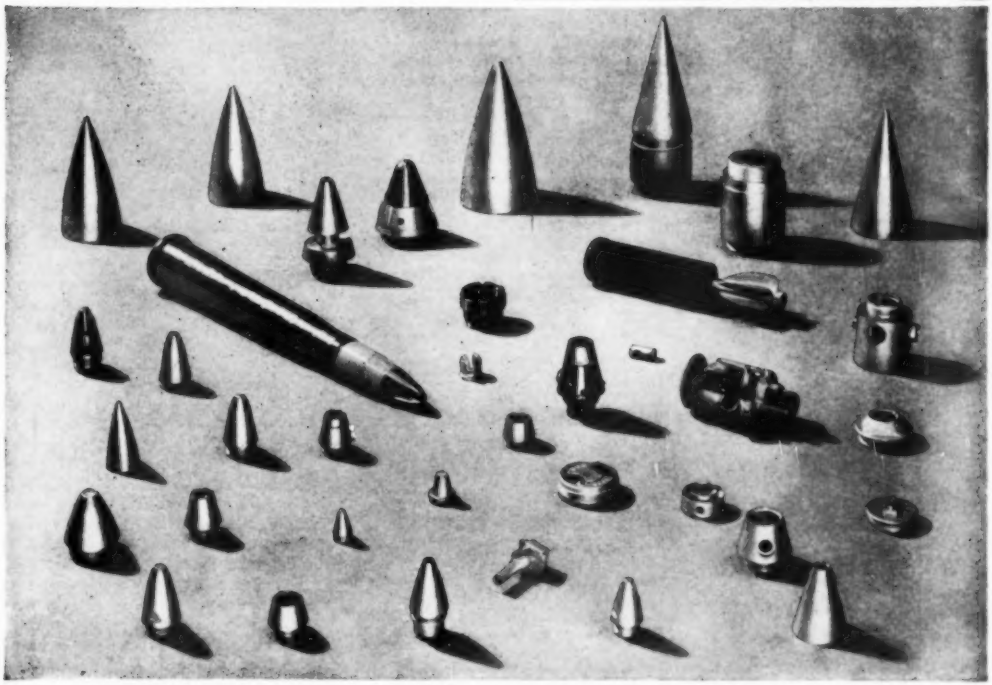

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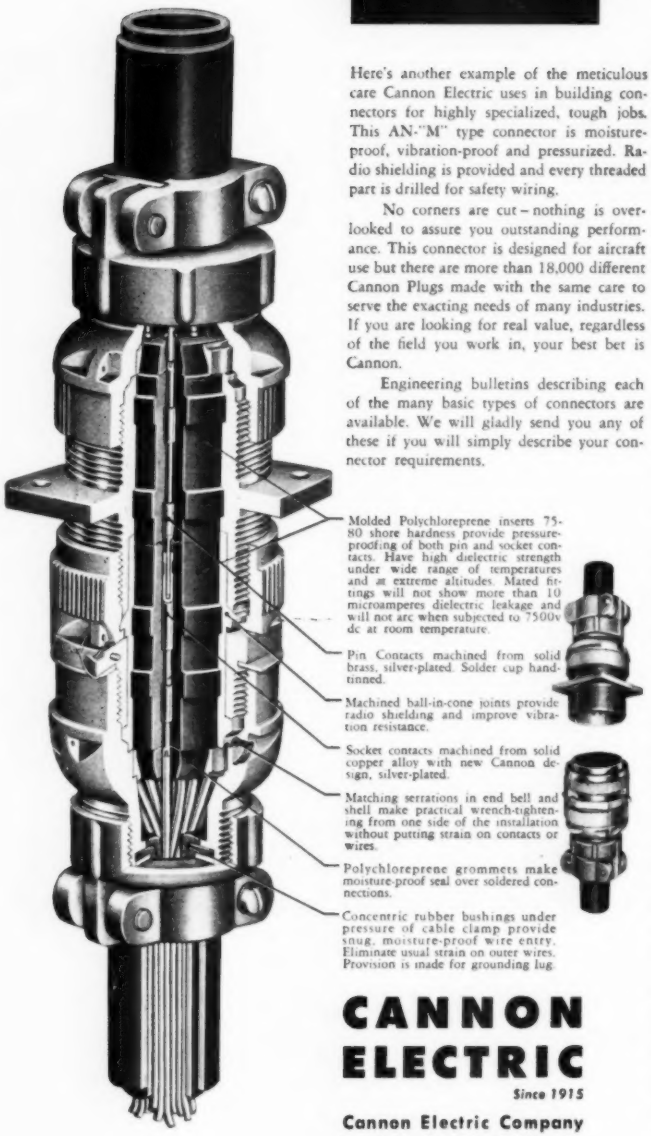
Here's why those in the know

—demand

CANNON PLUGS


Molded Polychloreprene inserts 75-80 shore hardness provide pressure-proofing of both pin and socket contacts. Have high dielectric strength under wide range of temperatures and at extreme altitudes. Mated fittings will not show more than 10 microamperes dielectric leakage and will not arc when subjected to 7500v dc at room temperature.
Pin Contacts machined from solid brass, silver-plated. Solder cup hand-tinned.
Machined ball-in-cone joints provide radio shielding and improve vibration resistance.
Socket contacts machined from solid copper alloy with new Cannon design, silver-plated.
Matching serrations in end bell and shell make practical wrench-tightening from one side of the installation without putting strain on contacts or wires.
Polychloreprene grommets make moisture-proof seal over soldered connections.
Concentric rubber bushings under pressure of cable clamp provide snug, moisture-proof wire entry. Eliminate usual strain on outer wires. Provision is made for grounding lug.

Here's another example of the meticulous care Cannon Electric uses in building connectors for highly specialized, tough jobs. This AN-"M" type connector is moisture-proof, vibration-proof and pressurized. Radio shielding is provided and every threaded part is drilled for safety wiring.

No corners are cut – nothing is overlooked to assure you outstanding performance. This connector is designed for aircraft use but there are more than 18,000 different Cannon Plugs made with the same care to serve the exacting needs of many industries. If you are looking for real value, regardless of the field you work in, your best bet is Cannon.

Engineering bulletins describing each of the many basic types of connectors are available. We will gladly send you any of these if you will simply describe your connector requirements.

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weapons with much higher velocities and destructive effects.

Twenty Years Ago

TANKS OF THE PAST

The medium tank, T1, is the third tank developed by the Ordnance Department since the World War and was completed in 1925. This tank weighs 23 tons and with its 200-horsepower Packard engine had a maximum speed of about 10 miles per hour. Recently this tank has been re-engined with a 330-horsepower Liberty engine to give it a maximum speed of 14 miles per hour, as a lack of power was its principal defect.

The medium tank, T2, completed in 1930, while having the same general armor protection and firepower as the 23-ton tank, weighs only 15 tons and, in addition, has a maximum speed of 22 miles per hour. The turret mounts our newest tank gun, a 3-pounder or 1.85-inch semiautomatic gun, and a caliber .50 air-cooled machine gun in a dual flexible mount with a telescopic sight. . . The guns may be moved fifteen degrees right or left and up or down, independent of the turret, by the single turret gunner who controls the guns and mount from a shoulder support.

The armor protection is one inch thick on the vertical surfaces in the most important places. In addition to the turret guns, a 37-mm. auxiliary or reserve gun is provided next to the driver; this gun can only be fired forward.

While the medium tanks have been developed to take the place of the heavy 44-ton Mark VIII tank used during the war, and of which some are still on hand in the service, there exists also a requirement for a modern light tank about eight tons in weight to take the place of the 6-ton tank, M1917, which is now standard equipment in the tank units of our Army.

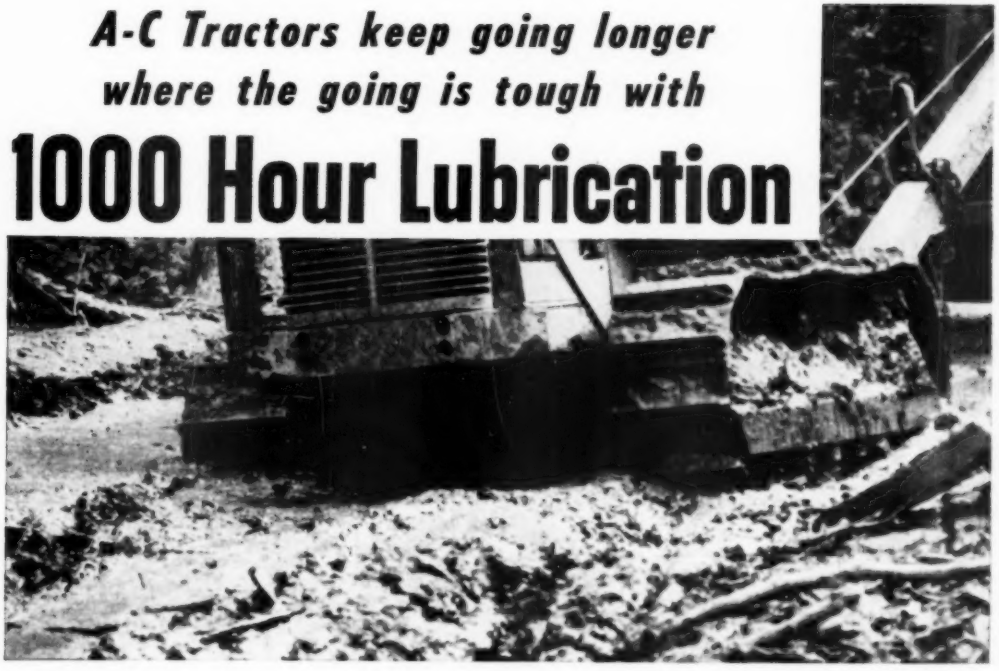
It may be well to state at this time that the 15-ton limit on medium tanks has been set with a view to their being able to cross the heaviest mobile pontoon bridges of the Army, while the limit on light tanks has been set to enable light tanks to be transported by truck.

As a matter of fact, a 10-ton tank could readily be transported in a modern truck, and we have actually recently moved both the 15-ton and the 23-ton tanks discussed above a distance of 60 miles over public highways by putting these tanks each on a large trailer behind a 6-wheeled, 10-ton commercial truck.

The light tank, T1E1, was completed in 1928; it weighs 7½ tons, has a maximum speed of 20 miles per hour, is armored against ordinary machine-gun fire, and

A-C Tractors keep going longer where the going is tough with

1000 Hour Lubrication



FULL PROTECTION — truck wheels, idlers and support rollers require only one greasing every 1,000 hours with Allis-Chalmers *Exclusive* Positive Seal Roller Bearing Design. Think of it! These tractors can operate for six months on a 40-hour-week basis with just one lubrication of 14 to 20 of the most abused, hardest-to-service points. This is just one of the many ahead-of-the-field design features found only in the four new Allis-Chalmers tractors.

1000-Hour Lubrication Offers These Big Benefits on Any Job

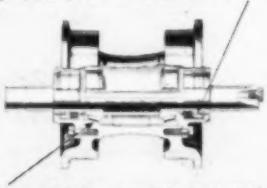
DAILY GREASING PERIODS ELIMINATED. Users save at least 30 minutes every day . . . gain about one full month's production every year.

FULL PROTECTION ASSURED. Positive Seals keep grease in . . . dirt and moisture out. 1000-Hour Lubrication gives protection unchallenged in the tractor field.

EASY TO SERVICE. No more cleaning of dirt, muck and grime from fittings every day. Operator can choose time and place to regrease when conditions are favorable.

Here's the secret:

Positive Seals ground smooth as glass, seal the grease in...keep dirt, grit, dust, mud and water *out*.



Tapered Roller Bearings protect the Positive Seals by letting truck wheels, idlers and support rollers rotate freely . . . without side thrust or wobble.

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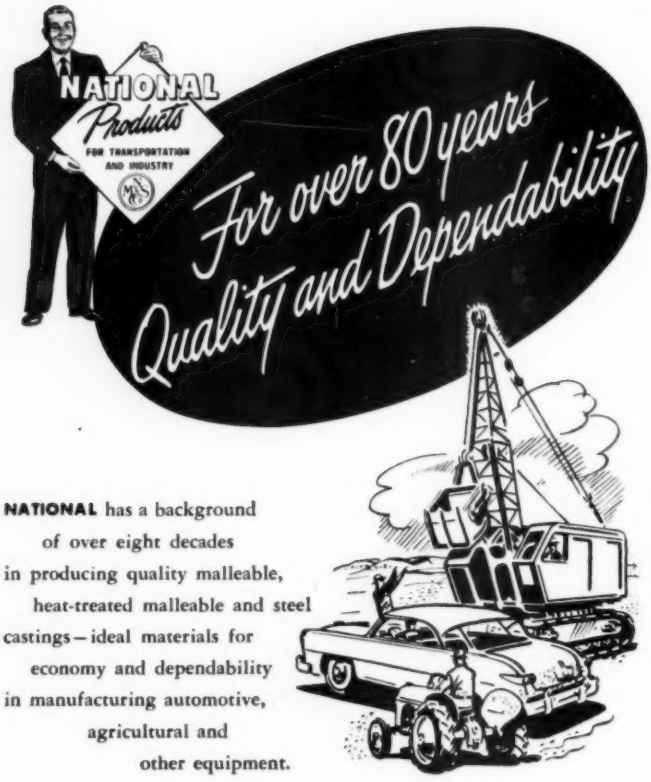

NATIONAL has a background of over eight decades in producing quality malleable, heat-treated malleable and steel castings—ideal materials for economy and dependability in manufacturing automotive, agricultural and other equipment.

NATIONAL'S unparalleled experience—coupled with a continuing metallurgical research program, rigorous quality control standards, and completely mechanized foundries in strategically located cities—is at your disposal.

Sales offices and engineering facilities are located at all five plants listed below.

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A 16mm technicolor film. Narrated by Edwin C. Hill, this 27-minute film tells how malleable iron is made . . . tested . . . used . . . how its production economy, ductility, machinability, toughness will give you a better finished product. Available for group showings. A-5017

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NATIONAL Products FOR TRANSPORTATION AND INDUSTRY Est. 1868

Ordnance in Review

carries a crew of 2 men. The armament in the turret consists of a 37-mm. gun and a caliber .30 air-cooled machine gun mounted in a combination mount of the type previously described.—*From "Mechanization in Our Army Today," by John K. Christmas, published in the July-August 1932 issue of* ARMY ORDNANCE.

In contrast, today's light tank, the M41 Walker Bulldog, weighs 26 tons, mounts a 76-mm. high-velocity gun, and has a top speed of 40 miles an hour. Our M46 Patton tank weighs 48 tons, carries a 90-mm. gun, and its 810-horsepower engine pushes it along at 30 miles an hour.

Ten Years Ago

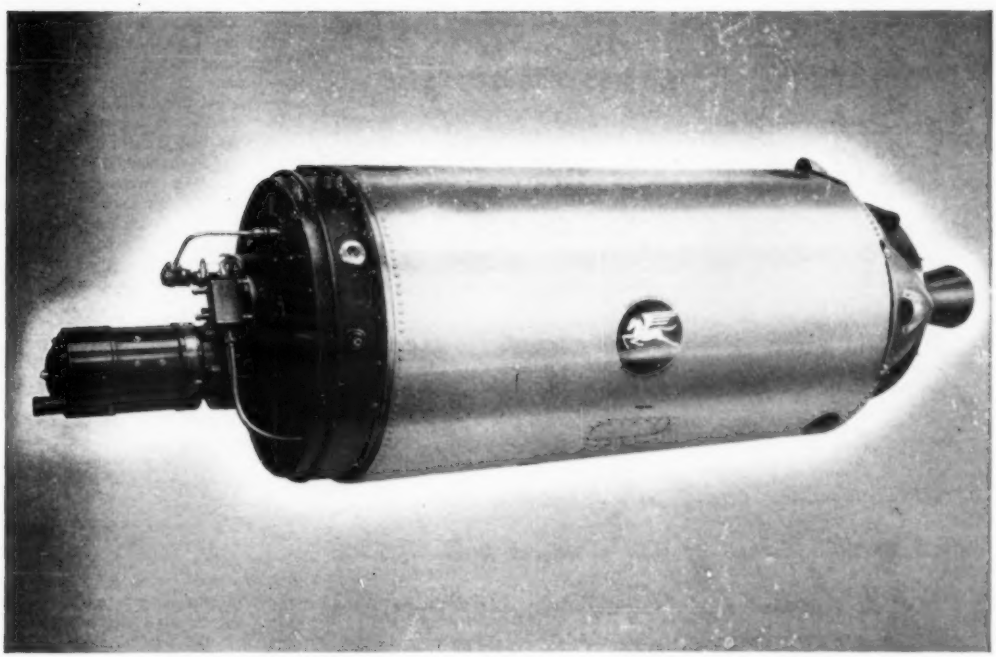
ARTILLERY DEVELOPMENT

Classified as divisional pieces used by artillery forces are the 75-mm. pack howitzer, 75-mm. field howitzer, 75-mm. gun, and the 105-mm. howitzer. Of these, the 105-mm. howitzer is a fieldpiece comparatively new to troops and the public. But the 105-mm. howitzer is no new thing to the Ordnance Department. The version of the 105-mm. howitzer that is now in production represents studies and revisions of models that were started some fifteen years ago. At all times over the past ten years the Ordnance Department had complete designs and drawings of a 105-mm. howitzer that could be placed in immediate production pending the availability of funds.

The 105-mm. howitzer has been developed to furnish greater firepower for our forces by creating a weapon having plunging fire and utilizing a much heavier projectile with greater destructive effect than the World War 75. Nine commercial companies and three of our arsenals are producing various components for the 105-mm. howitzer, and production has reached the stage where these weapons are being issued rapidly to troops and will shortly become a familiar artillery piece to the public.—*From "Ordnance," by Maj. Gen. C. M. Wesson, published in the January-February 1942 issue of* ARMY ORDNANCE.

The 105-mm. howitzer became the "work horse of the Army" all through World War II and is still our principal divisional weapon. Ordnance development through the years of peace paid off in powerful weapons when war came. The development and production of superior weapons is the never-ending task of the Industry-Ordnance team.

NOW...MORE POWER FOR AMERICA'S ARMED FORCES



The J-44 Turbo-Jet Engine...Designed and Built by Fairchild

Here is more power to help meet America's defense needs–the J-44 turbo-jet.

Fairchild designed and built, it weighs 300 pounds and delivers 1000 pounds thrust. Compact, measuring 22 inches in diameter and 72 inches in length, it is one of the smallest engines ever made in its power class. The J-44 is another example of the Fairchild Engine Division's ability to create specialized power plants to meet exacting design requirements.

Presently Fairchild is designing and developing many other unconventional power plants–some of them for unusual applications–for our Armed Forces and is producing in quantity major components of the General Electric J-47 turbo-jet engine.

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More and more POWER developments for America's Armed Forces

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In 1903 I started Clover Mfg. Co. with Clover Lapping and Grinding Compound—the first Abrasive Compound in the world—originally sold only in Duplex Cans. Since then, single grade cans, in many sizes and grades, have been added. It is shipped the world over—Most all shops use it.

When Clover appeared in 1903, the only shop abrasives were ground glass, flint, garnet and emery. The only greases available were petrolatums, which melt at body temperature. Emery could not be used on ferrous metals because, under friction, it becomes magnetic, imbedding itself in the pores of the metal.

Clover Compound gave to industry a new type of grease with melting point of 250°F., mixed with Silicon Carbide one of the hardest and sharpest abrasives known, which is absolutely non-magnetic.

Won't you allow me to send you Samples and up-to-date literature? After 49 years of Service, Clover is still most in demand by industry.

E. B. Gallaher

Are you reading the Clover Business Letter? If not, send for a free card.

CLOVER MFG., NORWALK, CONN.
Since 1903
Manufacturers of Clover Lapping and Grinding Compounds and a full line of Abrasive Papers and Cloths.

COMMUNICATIONS

A-BOMB AND KOREA

THE EDITORS.—It was somewhat disturbing to read in a recent issue of ORDNANCE the article, "The Overvalued Atom," by J. M. Spaight, a British writer, in which he attempts to belittle the effect of the atomb bomb in modern warfare.

In the first paragraph he states: "It (war in Korea) has shown, first, that the atomic bomb is not the infallible deterrent of aggression which in some quarters it was supposed to be. It has shown, secondly, that there is a lot of life yet in that old dog, the foot-slogging infantryman, and that strength on the ground is still needed to hold a powerful onslaught by a large invading army."

Regarding the first point raised by the writer, there has never been any action or commitment by the Government in Washington or by the United Nations to use the atom bomb as a deterrent of aggression. On the contrary, the United States Government has definitely refused to so use the bomb in Korea.

With regard to the second point, the reasoning is fallacious in that the writer fails to point out that the infantryman in Korea has been denied the full effective use of modern air power—and also the use of all available weapons of war. Our ablest and most distinguished military analysts have pointed out several times that had our air force been allowed to blast the enemy's lines of communication and supply the war in Korea would have been over several months ago. A very complete answer to this article is another one by Maj. Alexander P. de Seversky in the September issue of the *American Engineer*.

It is regrettable that an article filled with half-truths and unrealistic conclusions should be given such prominence and circulation by the American Ordnance Association.

JAMES B. WRIGLEY.
Spokane, Wash.

WHAT IS A "DIVISION?"

THE EDITORS.—In THE COMMON DEFENSE for March 1952 I read with great interest the matter therein pertaining to our armed services. It seems to me it would be most informative to all of us who are not familiar with the present tables of organization, particularly of the Army, that we be brought up to date on this matter—especially as to the strength of the present "division." It is my understanding that during World War II the division consisted of a number of dif-

Neither sand nor snow nor H_2O
will stay these carriers*
in their appointed rounds.

Definitely an . . . **"EAGER BEAVER"**

*With apologies to "Uncle"

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For generations Tool Engineers have tried to develop a practical Open End Ratchet Wrench. Now *TAC* has done it... both as a socket type and as a Crowfoot type.

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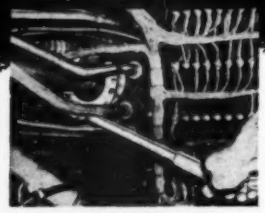
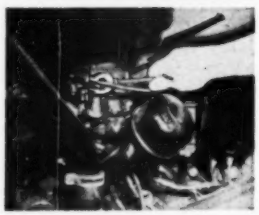
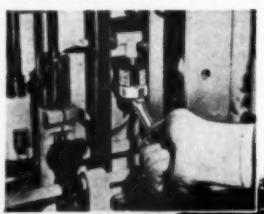
Proof of TAC's phenomenal performance throughout all Industry would fill volumes. Our plants are currently producing at capacity for all the Armed Forces and for Defense Industries.

The TAC Open End Ratchet Wrench is fully protected by Patent numbers 2578686 and 2578687, other patents pending. The name TAC is the registered trademark of TUBING APPLIANCE COMPANY.







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Communications

ferent auxiliary units not formerly connected with it.

I think there has been a lot of loose talk indulged in regarding this word "division." The public should be informed so that some comparison between our Army and those of Western Europe can be established. The statement is made by Dean Acheson that Western Europe will provide "fifty divisions." I understand that only twenty-five of these are in actual existence at the present time.

Exactly what tables of organization apply to these particular divisions? Are they patterned on the United States Army for the same strength and auxiliary equipment, or are they based on the French tables of organization, or a combination of the two? While we are about it, how about finding out the strength of the British division? They seem to do most of their active campaigning with the "battalion" as an infantry unit.

Then again we hear that the Russians have a great number of "divisions" massed on the UN borders. What is the Russian unit or division, and what does it consist of? I have heard that the Russian division is considerably smaller than the United States division. It seems to me that the public deserves to have this term defined and qualified.

TAYLOR STANLEY.

Cincinnati, Ohio

CRITICISM WANTED

THE EDITORS.—I wish to register a protest against the bulletin I receive every month entitled INDUSTRIAL PREPAREDNESS. This seems to be merely a list of names, and I do not see any value in it.

THE COMMON DEFENSE does have a few newsworthy items. All in all, I believe there is too much fear of criticizing the actions of our military procurement and development services. I do not mean that the facilities of the American Ordnance Association should be used as a critical body only, but constructive criticism, I believe, would do much more good than a glossing over of the facts, as well as the terrific overconfidence which all of the reports seem to have.

I am sure that many of the men now using the weapons reported on do not agree with the laboratory reports of their being the best in the world on all counts. This was not true in World War II, when some of our equipment was definitely inferior. We must not follow the complacent attitude that, because it is ours, it is the best. This does not apply, whether it be to rifles, artillery, planes, or tanks. Any one reading your publications would sit back and say, "there is no need of doing anything—we already have the best." (*Continued on p. 982*)

How to make shorter work of finishing* problems

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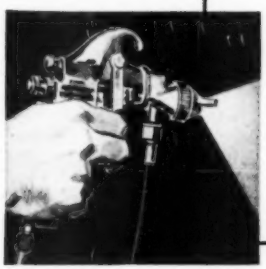

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Nelweld operator welding 7/8" dia. studs at a rate of 4 or 5 per minute on a mounting flange of a coal pulverizer casing. Photo courtesy of Combustion Engineering-Superheater, Inc.

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THE PROBLEM — How to cut down production time necessary for the installation of ninety-six 7/8" dia. studs on the mounting flanges of a large, heavy casing—requiring considerable labor and equipment time for handling, drilling, and tapping.

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Communications

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Trenton, N. J.

SATISFIED

THE EDITORS.—I have read your bimonthly magazine and newsletter with much satisfaction. Your articles are extremely well-written, presenting basic facts and sound theory—an organization and magazine you can well be proud of.

My interest and enthusiasm have been aroused through your publication and contacts with a member. Enclosed you will find my application and check. Please enroll me as an active member.

ALVIN R. WILFORD.

Lynn, Mass.

"WORK" VS. "ECONOMY"

THE EDITORS.—As a member of the Ordnance Association and a reader of THE COMMON DEFENSE it is gratifying to see that some effort is being made to emphasize economy in the military forces.

I wonder, however, if you are going far enough and getting down to the basic trouble, which is "work." The mere appropriation of money is not enough—men must work and produce according to their ability. A man is worth his "hire" only. Some are worth $100 a day, some are worth 5 cents a day, and some you do not want at any price. Surely they are not all worth the same or produce the same worth per day.

In INDUSTRIAL PREPAREDNESS No. 65 the paragraph on cost-consciousness is good, and long-delayed. Why not go further and require each graduate of the military schools to spend two years in industry and find out how a dollar is created and how it should be spent in order that a profit might be made or some left for emergencies? How can the Nation be strong if some of the basic fundamentals of economy are not practiced?

Keep up the editorials but go further with the subject matter.

MARVIN J. UDY.

Niagara Falls, N. Y.

THE NEW RIFLE

THE EDITORS.—I was very much interested in the article "The New Light Rifle," which appeared in the March-April 1952 issue of ORDNANCE. This is the kind of information most readers like to have, and it is difficult to get such authentic and complete data elsewhere.

The development of this lightweight rifle indicates that our Ordnance people are alert to the soldier's need for a powerful yet easily carried weapon that will not burden air transport.

ROBERT EMSWORTH.

Baltimore, Md.

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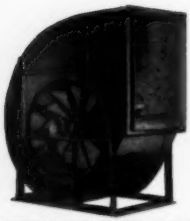
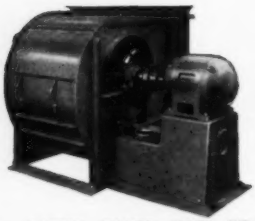


LIMIT-LOAD FANS.—For large-scale ventilation. Quiet, non-overloading. Sizes up to 500,000 c. f. m. Bulletin 3675.



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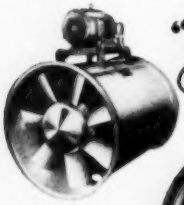
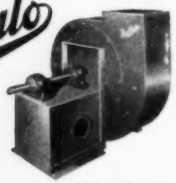


"Buffalo"



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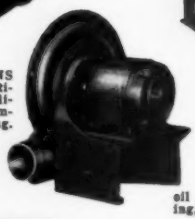

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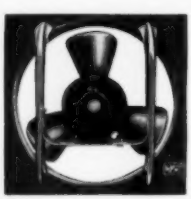
"E" BLOWERS-EXHAUSTERS For oil or gas furnace blowing, line boosting, cleaning. Bulletin 3014-C.



BREEZO FANS.—Easy-to-install wall fans. Durable and very economical. 6 sizes. Bulletin 3222-F.

TYPE "CB" AND "C" PRESSURE BLOWERS.—In sizes for pressures up to 4 pounds and capacities up to 75,000 c. f. m. Bulletin 3553-A.

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Winston Churchill 1874-1951. By Lewis Broad. New York: Philosophical Library. 611 pp. $6.

IN 1941 Lewis Broad published his biography of the twentieth century's outstanding personality. It was a voluminous and detailed account of the character and career of its protagonist that four years later and again in 1951 was brought up to date.

The biographer makes the interesting comment that originally he started the work on the assumption that his subject was a "volatile demagogue." Soon after beginning his research he discovered adequate reasons for changing his views. Under the circumstances, he lays claim "to the impartiality of a critic converted from his criticism. If the book is now written on a note of admiration it is only because the facts have compelled me."

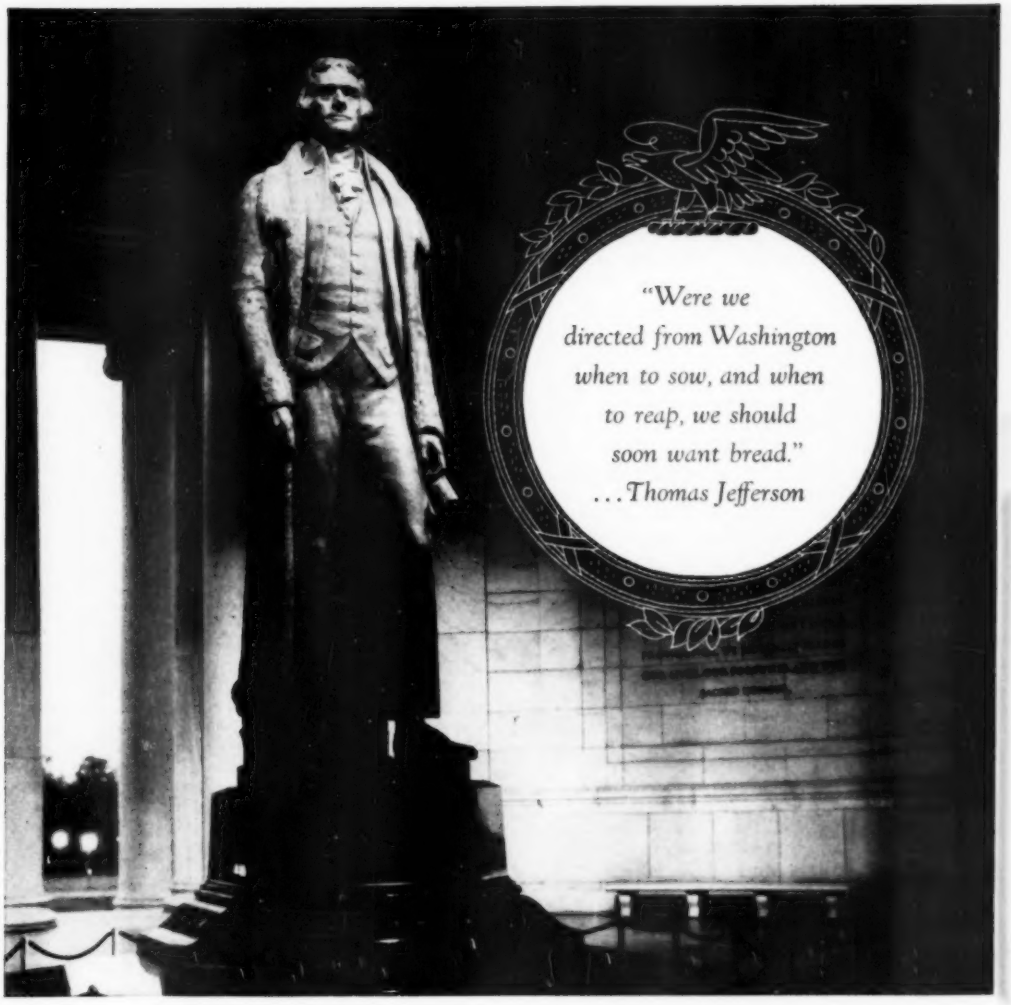
The history of our times has been made to a marked degree by Winston Churchill and described in inimitable prose in his many admirable works. This biography is a most entertaining, authoritative, and well-written life of Britain's great leader. It is an effective background for a better understanding of Mr. Churchill's autobiographical works.—DONALD ARMSTRONG.

Hitler's Strategy. By F. H. Hinsley. London: Cambridge University Press. 254 pp. $3.75.

THE story of Hitler's own lonely intentions, deduced from the German Naval Archives, which were captured in their entirety, is an enlightening analysis of the self-appointed "superman." The difficulties encountered by a supreme leader in dealing with experts, particularly when that leader places his intuition above known facts, proves the adage that a "person who is his own doctor has a fool for a patient."

Hitler glossed over his mistakes and omissions, shrugged off his failures, always believing in himself and that his major purposes must prevail because he wished it so. The Germans had lost the war in 1942 and his military experts knew it, but Hitler's nonrecognition of the signs and his overriding authority made surrender impossible. The experts were forced to continue for several more years attempting the victory which was never there.

This is a fascinating presentation, carefully documented and



One political party, today, claims Thomas Jefferson for its very own. You hear much of this claim at the various "Jefferson-Jackson Day Dinners" this time of year.

He is, indeed, its revered philosopher. In view of this, it is well to recall what his philosophy really was, as revealed by his ever-living words, so pertinent today. He was the great foe of bureaucracy and of overcentralization. He was the implacable enemy of dishonesty in government.

His philosophy is as far from that of many of today's law-makers as white is from black. Let us revert to his principles, while there is yet time to *keep* our country great.

Walter E. Dituars President

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Book Reviews

well written, by an author who is somewhat eminent in the field of history. The execution of Hitler's plans are not touched on, but the formulation of those plans and the reasoning behind them are fully set down. Contemporary documents are used almost exclusively, and the facts can be checked by the interested reader.

This is an excellent analysis of the thinking of one who was hailed by many as a great strategist but who "came a cropper."—T. K. VINCENT.

Fighting Admiral: The Story of Dan Callaghan. By Rev. Francis X. Murphy. New York: Vantage Press. 207 pp. $3.

UNDER the title of "Fighting Admiral," Father Murphy has presented a readable biography of Rear Adm. Daniel J. Callaghan, U.S. Navy, who was killed on the bridge of his flagship, the U.S.S. SAN FRANCISCO, in the Battle of Guadalcanal, November 14, 1942.

With his own experience as a chaplain at the Naval Academy and a wealth of material at his disposal, Father Murphy has told the story well. He has made clear the factors of early upbringing, religious training, service associations, and naval experience which combined to make Dan Callaghan's strong character. Throughout there runs the strong Catholic influence which in large measure dominated his personal life.

The changes in the service resulting from World War I and from technical developments are covered sufficiently to make clear their effects on Admiral Callaghan as well as his own share in the application of methods old and new to meet new situations.

His three years as naval aide to President Roosevelt are related to bring out something of the President's interest in and effect on the Navy and to make plain the somewhat curious position of the naval aide, especially in that Administration.

Admiral Callaghan's whole life leads logically up to the climax when, in command of a small force of cruisers and destroyers, he is sent out on a desperate mission. His task is to stop a much larger Japanese force intent on bombarding the Marines struggling to wrest Guadalcanal from Jap defenders. The battle achieved its purpose, and the Jap naval forces were driven back. But the cost to us was heavy in ships and men.

The minor technical inaccuracies will not spoil the book for service readers, while for civilians there is much worthwhile history.—GEORGE F. HUSSEY, JR.

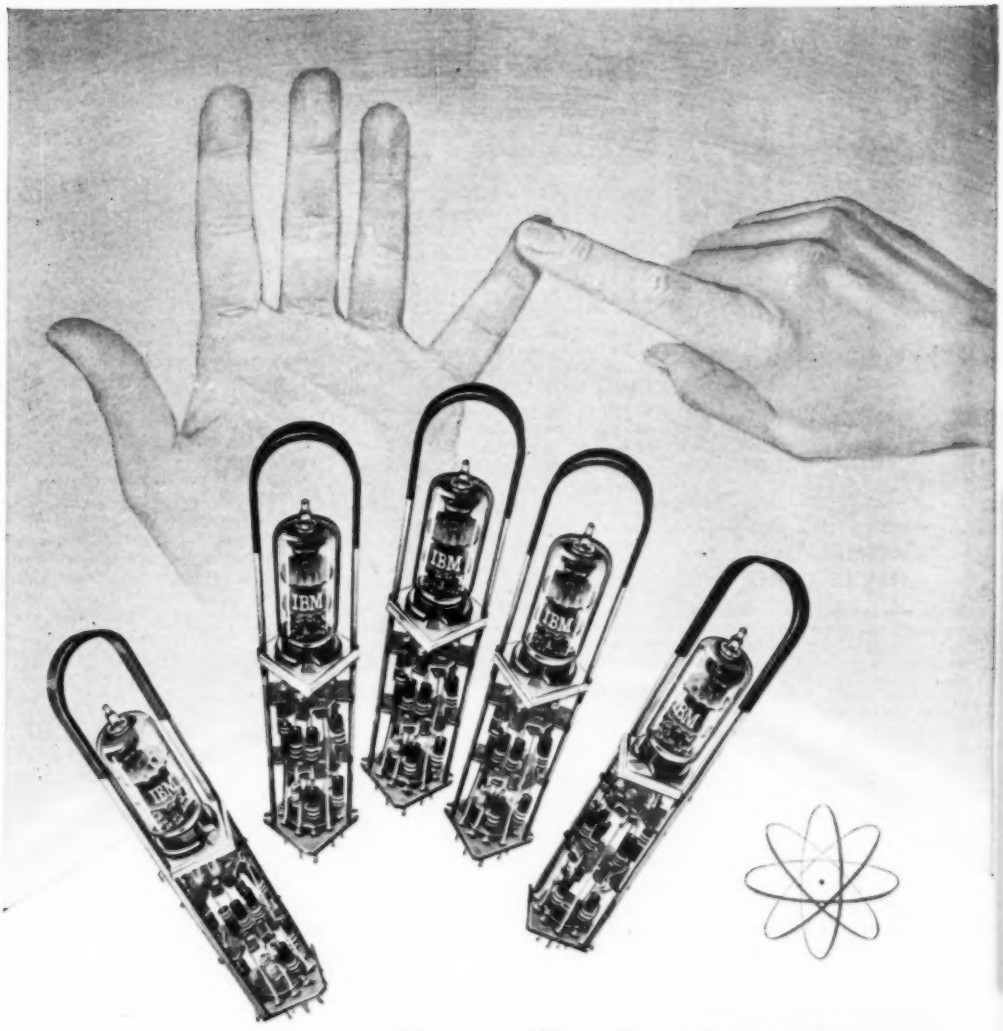
Production of Motor Vehicles. By H. M. Cunningham, W. F. Sherman, and G. W. Mason. New York: McGraw-Hill Book Company. 169 pp. $3.50.

UNDOUBTEDLY this volume would be more effectively reviewed by a member of the automotive-engineering profession who is familiar with the fine points of managerial techniques in planning, scheduling, and manufacturing. The stupendous achievement of the American automotive industry in these fields is proof that much of the best talent of American engineering and industry has gone into the making of our automotive prowess.

It is not by chance that the amazing results obtained by the automotive industry in our country have come about. It is doubtful that in any other leading industry has equal attention to perfection in all details of quality production been attained.

The authors of this book have had wide experience in various segments of the field: Mr. Cunningham is now associated with the Munitions Board of the Department of Defense and was formerly a staff member of the Automobile Manufacturers' Association. Mr. Sherman is manager of the engineering and technical department of the Association. The foreword is by Mr. Mason, president of the Association.

The amply illustrated text begins with the inception of the



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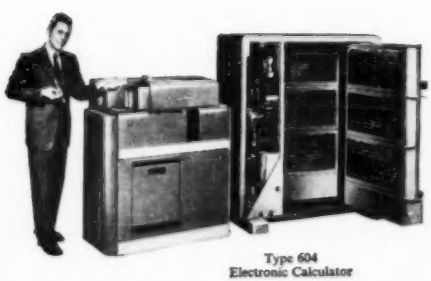

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new model and carries the reader through the many stages which lead to the finished vehicle coming from the production line. The authors discuss the administrative and technical problems resulting from proposed model changes, the preliminary planning for new-model production, the completion of the production plan, quantity control, control of quality by inspection, cost control, and distribution techniques.

It is an invigorating experience to have the opportunity to read this book and to know of the controls and policies which have made our automotive industry such a vast power for the economic strength of our country in peace and in war. That industry has transformed our whole mode of life, it has brought ease and speed to our travel, and has made accessible areas of the world which, until now, have been remote. The automobile has speeded up the process of modern living and at the same time has enabled us to keep up with it.

From an ordnance point of view the availability of the same plans and techniques of the automotive industry for the production of combat vehicles and all types of armament is a major support of our program for peace. The authors of this book, which is devoted to the commercial aspects of our automotive industry, have nonetheless presented a text which is also a key to our armament strength.—Leo A. Codd.

Materials Survey—Zinc. Compiled for the Materials Office, National Security Resources Board, by the United States Department of the Interior, Bureau of Mines. Looseleaf, tabular indexed. About 200 pp. Available for limited distribution by NSRB.

THIS is one of a series of surveys of basic strategic materials being prepared by the National Security Resources Board under a working-fund agreement with interested Government agencies. It is in the nature of a background compilation and repository of available data on zinc to render unnecessary the future endless writing of repetitive reports that has been a characteristic of Government operations.

The survey covers domestic and foreign data up to and including the year 1949; some tabulated figures go back as far as 1801. It provides information on production, consumption, stocks, prices, and also descriptions of the resources areas and reserves, companies engaged in production, ores, and production methods. It does not attempt to theorize on possibilities or to present solutions for problems, and the survey thus provides an excellent and officially reliable background for any person or agency intending to investigate any phase of zinc.—G. S. Brady.

Legend into History—The Custer Mystery. By Charles Kuhlman. Harrisburg: Stackpole Company. 271 pp. $5.

THE defeat and extermination, to the last man, of the 225 officers and men of the famed 7th Cavalry's five troops has been one of the most tragic and baffling episodes in American history. Many versions of the battle have appeared over the years, and many legends based upon unsound premises have come to be accepted as fact.

The definitive history can, of course, never be written as all the personel under Custer's immediate command were killed. However, this book represents what is probably the most serious attempt to date to reconstruct objectively the successive movements of the several elements of the Custer command.

Most histories tell generally *what* happened and approximately *when*, but what remains in violent controversy is the *why* and *how* of the results. Dr. Kuhlman apparently has devoted the major portion of the past sixteen years in reconstructing the Battle of Little Big Horn in an effort to solve these very problems. A wealth of interesting data have been revealed in the fruits of the author's painstaking research.

Each phase of the engagement, with the author's interpretation of what actually transpired from the time Custer divided his force and marched toward the Indian encampment until the Indians retired on the approach of Gibbon's column, is further clarified by reproduction on specially drawn maps. In addition, a separately printed contour map of the over-all principal terrain, plus an organization table of the 7th Cavalry (1876), are appended to the book.

This volume is addressed primarily to readers who are already familiar with the book's chief sources, including the more important of the previously published narratives. Nevertheless, this tense drama will hold any student of history from start to finish.—John J. Driscoll.

Biography of a Battalion. By James A. Huston. Gering, Nebr.: Courier Press. 306 pp. $5.

TO supplement the multitude of historical records of divisions and larger units in World War II, a book of this sort is urgently needed. James A. Huston who was the intelligence officer of the 3rd Battalion, 134th Infantry (35th Division) served in this capacity from Normandy to the Elbe.

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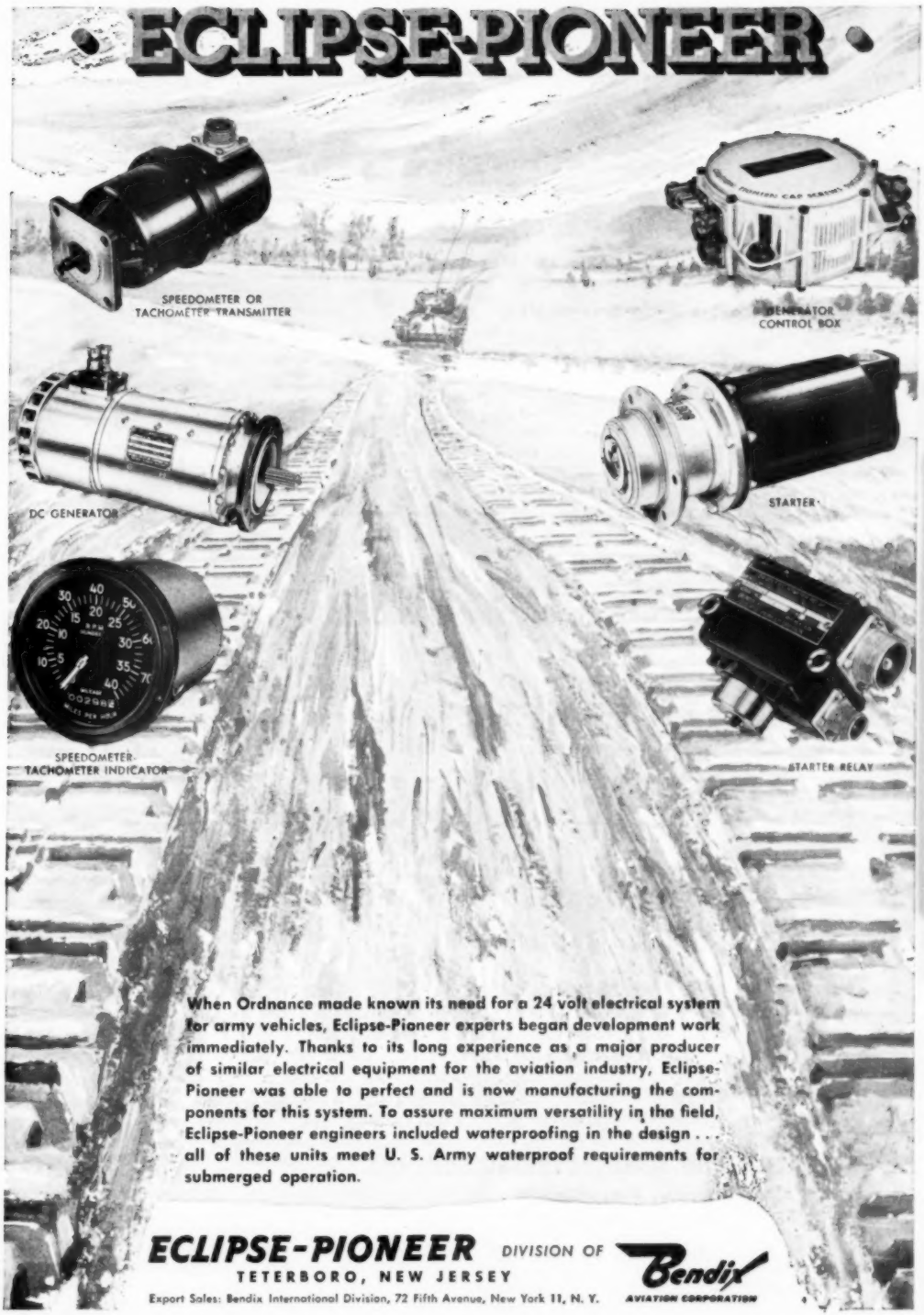

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MAPI Accounting Manual. Chicago: Machinery and Allied Products Institute. About 50 pp. $15.

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The Citizen's Stake in Price Control. By Robert A. Brady. Paterson, N. J.: Littlefield, Adams & Company. 161 pp. $1.50.

THIS book is intended as an unbiased analysis of the facts behind the control of commodity prices, and it attains the goal fairly well without the extreme tendencies of either a Government brochure or a Chamber of Commerce bulletin. The preliminary chapters on the how and why, and the criteria of price control, are analytic and generally fair.

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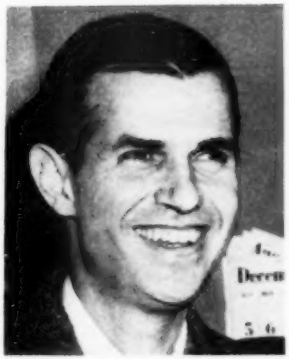

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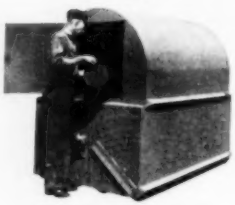

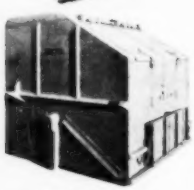

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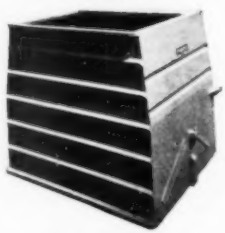

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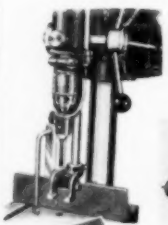

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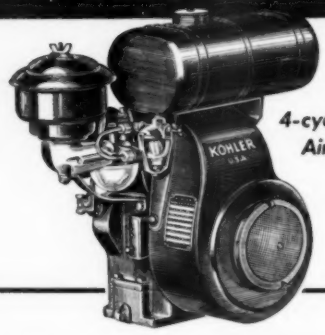

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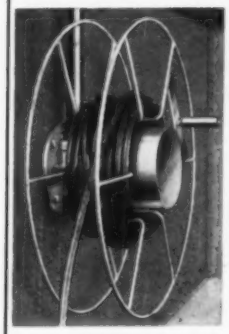

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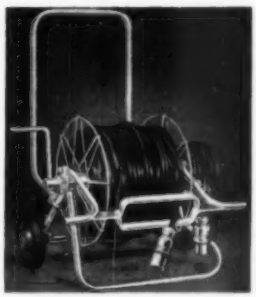

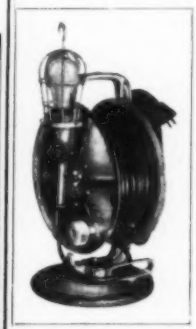

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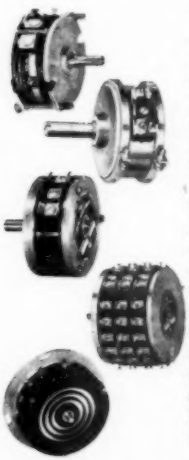

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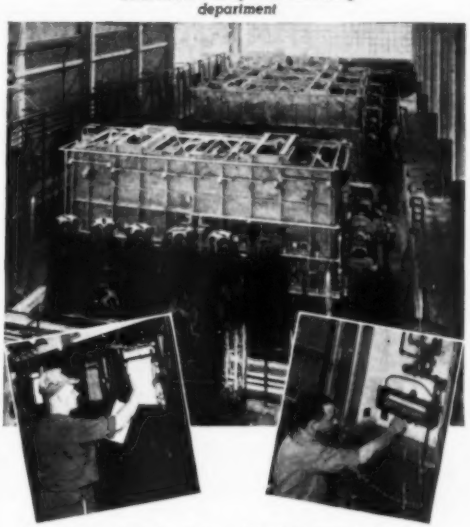

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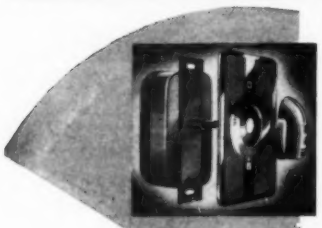

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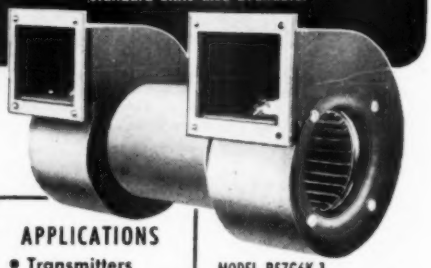

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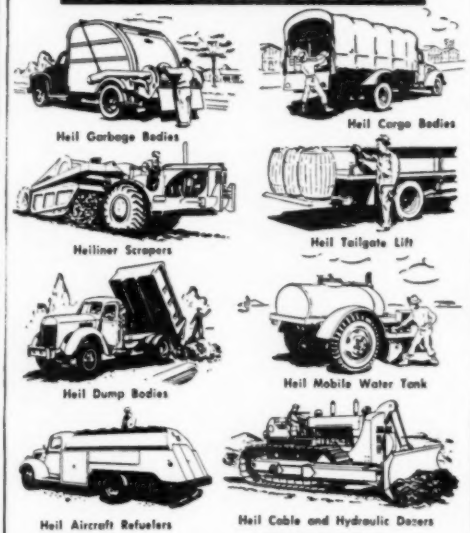

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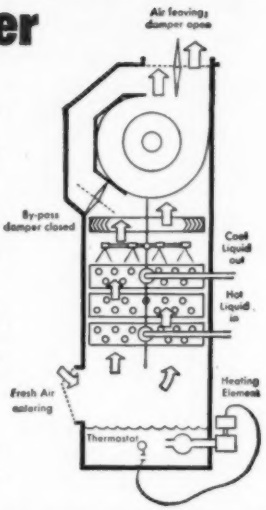

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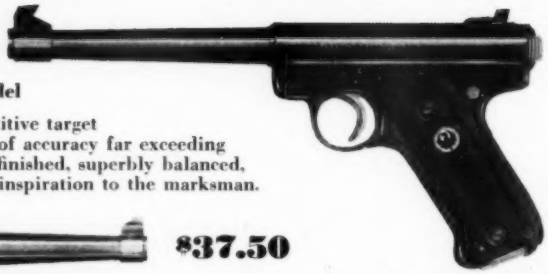

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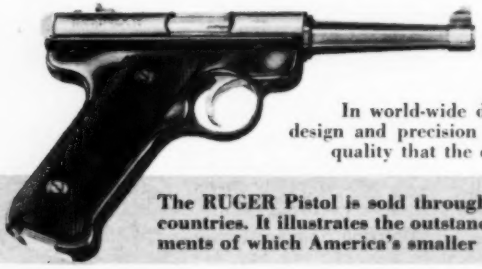

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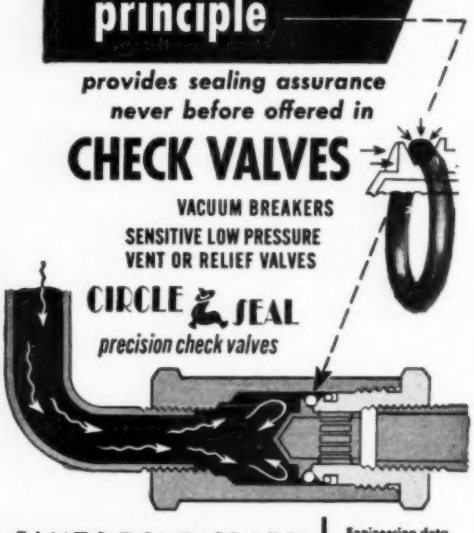

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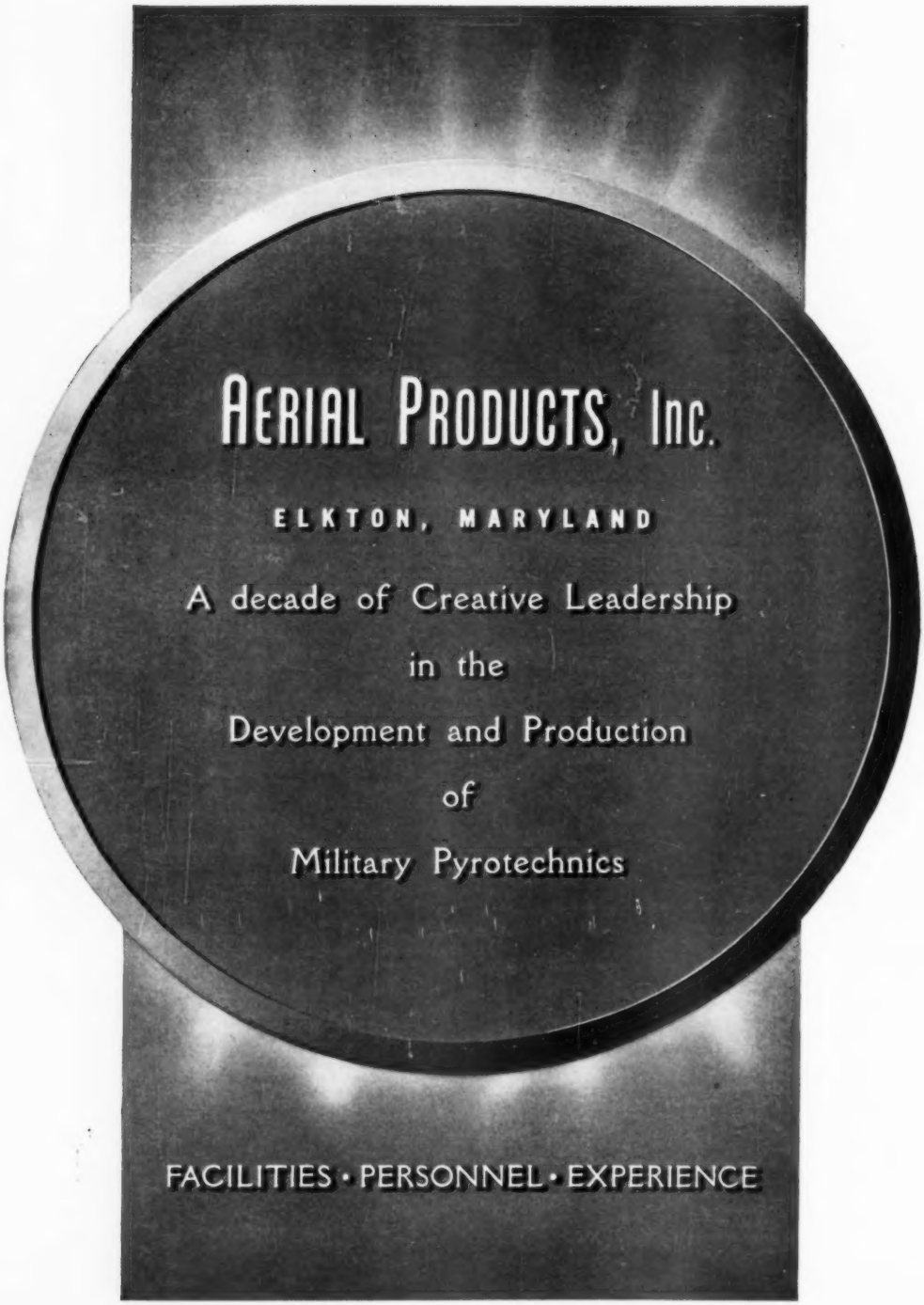
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ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

The Birth of a Weapon

Some Observations on the Arms-Development Process

Lieut. Col. M. M. Johnson, Jr.

Automatic arms expert and inventor, Ordnance Inactive Reserve

FUNDAMENTALLY, no arms development can be sound and enduring unless it is based upon a well-founded concrete conception of the arm, both in the mechanical (technical) and user (tactical) aspects. The relative weight of technical limitations and tactical requirements varies with each problem. The late John Browning had a very smart user concept when he refined a then venerable lever-action rifle system into the small, light, compact Model 1894 .30-30 Winchester carbine, whereas technical problems predominated in his M1917 Browning water-cooled belt-fed machine gun. The tactical requirements were by then quite obvious.

Four Major Factors

Conception in turn is inevitably based upon four major factors: Imagination, understanding, experience, and judgment.

The conception of a development and the factors supporting it may be in the mind and brain of one or possibly two or three close-working "engineers." Committee, bureau, or board conception is likely to be rare.

A broad understanding of user requirements and technical limitations must be supplemented by a keen, well-controlled imagination. This is not planless reflection nor cerebral free-wheeling. Imagination is the gift of understanding, reconstructing, and looking ahead, seeing in the mind where general or specific design features may or must lead. Imagination is perhaps a gift which can rarely be acquired but only aroused and trained. It cannot substitute for experience or understanding, yet it can supplement both.

Finally comes the factor of judgment, or decision if you prefer. All the elements of conception now must come to roost. At such times many are heard but few stand up to be counted. It is more often the problem of one or a few of the key members of the project engineering team to exercise final judgment and make the bitter decisions which commit the weapon: belt feed with open or closed loop belt; magazine or clip; gas or recoil; bipod or tripod or both; air or water cooling; front lock or rear lock; elephantine longevity or short-lived mobility; single-purpose weapon supreme in its sole specialty or all-purpose, pinch-hitting whammer of the we-fight-everywhere persuasion?

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The Pilot Model

Descending from the stratosphere of fancy to the indispensable forges of fact, our arms-development process next reaches the realm of the pilot model.

There are those who believe the first prototype should be so thoroughly engineered and so carefully conceived as to be near-perfect. This, it is argued, shortens preproduction time, demonstrates true scientific skill, and discourages dawdlers in development.

If such pseudoscientific pronouncements were really well-founded and practical, which they are not, surely the Wright brothers should have remained in their bicycle business, forsaking the dubious, desolate dunes of Kittyhawk.

Thus we arrive at the first specific design-development phase which gen-

erally consists of: (1) integration of the design by sketch, (2) layouts (on paper), (3) details (on paper), (4) model-shop fabrication, (5) adjustment and assembly of parts, (6) adjustment of the assembly and corrections, (7) tentative testing.

Comments are now in order. Usually several project engineers take part in this phase of the process. Occasionally layouts and details are circumvented by shop sketches.

Model Must Fire

The resulting pilot model represents the essentials of the proposed arm but does not necessarily incorporate all details. Unless the basic mechanism in, say, an automatic gun, proves capable of firing, all other details such as unlocking, opening, extracting, ejecting, safety device, trigger shape, cyclic-rate control, etc., serve little purpose.

Ultimate provision for all these should be anticipated generally in the pilot design, but the cart gets nowhere without the horse. The pilot model first must whinny.

With one basic skeleton pilot model a little testing goes a long way. Scientists like to deal with facts. There is no more cruel, harsh, inescapable fact than a first pilot model. It is worth much more than pounds of paper formulas and footnotes of assumptions. Armed with the concrete pilot mechanism, experienced development engineers can apply imagination, experience, understanding, and judgment in the next and highly important phase of the arms-development process which is *evaluation*.

Evaluation may result in abandoning the whole system and making a new try all around. It usually results in a series of changes. The ignition system may require radical revision. The extractor may require increased bearing. The unlocking time may require retardation. Cam angles may require reduction. A power increase may be indicated. The ejection system, its force or direction of ejection, may require change. Any one of these changes enforces a chain reaction of changes in related components.

There is a tendency for earnest people to get trigger-happy with first models. Every one wants to get into the act. Profound pronouncements are made as to the metal finish, shape of stock, trigger pull, sights to be mounted, balance of the piece, its appearance.

User Requirements

Those who mainly concern themselves with user requirements will be heard to pontificate over the barrel life under anticipated continuous burst fire, the need for both belt and magazine feed (with optional clip loading), the need for one-mil automatic bursts from the bipod, cyclic-rate device, range-computing sights, carrying handle, buttstock accessory kit, bayonet lug, stacking swivel, detachable telescopic sight, grenade launcher, sling swivels, sling, and means to signal the operator when the gun is empty. Light weight, simplicity, and other important factors may be touched upon in passing.

Judgment Essential

Not infrequently the situation develops to a point somewhat parallel to constructing a horn, two windshield wipers, and a built-in radio-instrument panel, thereafter to build a car around these necessities of automotive engineering. But try as you will, there is no substitute for judgment in the evaluation process.

The fact is you're a long, long way from the goal line even though your first pilot model shows great promise.

The second specific design-development phase consists of the same steps as taken in the first phase, plus extended testing. Normally the functioning of the second pilot model is very substantially improved. Mechanical defects are not so obvious. However a gun which fails to feed once in a hundred times, and misfires once in ninety, is often more difficult to correct than a first model which fails to perform each of these functions ten to thirty per cent of the time. This is due to the fact that many gun functions can be marginal, seeming to work but having little margin to spare. No sound gun mechanism can operate on narrow margins. There must be power and performance in reserve, especially for rainy, muddy days. Hence evaluation again becomes vital at this stage.

The Third Phase

It is not extraordinary for this second pilot design phase to be repeated up to half a dozen times. Eventually one reaches the third major phase where some three to six guns, all identical, are built from a revised and corrected design, all parts having production tolerances to insure interchangeability and mass manufacture.

In these guns all elements and devices are important. The sights are included. The bipod is attached. The

The T47 model of the new light rifle, left, weighs about eight pounds, is gas-operated, and can be fired either semi- or full-automatic. It is shown here about to fire a practice rifle grenade.

trigger pull is within prescribed limits. Ease of field disassembly has been covered, a carrying handle and flash hider included. Total weight of the gun has been reduced to a practical minimum.

Evaluation at this stage is especially difficult because of the viewpoints involved. Chiefly these include the user, the designer, and the manufacturer. Not infrequently a final decision must be made at a higher policy level. This is not different from a commercial item, the fate of which is in the hands of the design group, sales group, factory group, manager (president), treasurer, and board.

Tedious Process

The development process is especially tedious and difficult at the final-model phase. In many cases there are several successive series of six up to several hundred models prior to final adoption or rejection.

When the weapon is adopted and produced, manufacturing changes are usually imposed. Often after a few months up to several years of production substantial changes may be required in the design.

In all these phases of the arms-development process there is no substitute for judgment, no escape from the need for its exercise. Imagination, understanding, and actual experience cannot be ignored. Throughout the process there is no refuge from the four P's—patience, perseverance, perspicacity, and perspiration. The late John Browning once described the gun-development process as one which required "a drop genius in a bucket of sweat."

Without doubt the development process is difficult. One does not "spring to a new arm overnight," notwithstanding occasional hokum from the Sunday-supplement writers. For example, some years ago a new weapon was developed rather rapidly by taking a previously perfected breech mechanism complete, a modified old-time lower-powered cartridge, a long-established feed system, and an extensively tested take-off.

Elements Reduced

All these elements were reduced to the small-cartridge scale by a team of some half-dozen experienced arms engineers to meet a clear-cut set of requirements. The first models worked quite well, there being very few if any "unknowns." The development process was rapid. According to extensive subsequent Hollywoodian hokum, however, this highly creditable and successful arm was whipped up in a wink by one weapon wizard.

The arms-development process produced the 75-mm. recoilless rifle which has proved its worth in the rugged mountain fighting in Korea (Army photo).

Blazed Own Trail

In contrast, Hiram S. Maxim blazed his own trail almost every step of the way in the long process of developing the original Maxim short-recoil, belt-fed, water-cooled "automatic machine gun." Though he had gained experience with his original gas-operated, air-cooled, belt-fed machine gun, John Browning was obliged to cover much uncharted technical ground during 1900-1917 in creating the M1917 heavy Browning still in use today.

Isaac Lewis utilized in some degree a predecessor's mechanism, but much tedious painstaking effort was required of the Lewis gun inventor.

Years Required

On the average, with not very many exceptions, the arms-development process requires from three to a dozen years, depending upon the scope of the development.

The well-known M1 semiautomatic rifle passed through an exhaustive 9-year development process prior to its adoption, and important changes were made in this piece several years thereafter.

A major problem in the arms-development process arises from what are termed "requirements." The number of arms, both sporting and military, for which no "requirement" existed until after the arm was substantially developed, is quite significant.

On the surface, no new development should be initiated unless there is a specific demand for such an arm, feature by feature, paragraph by paragraph. This policy appeals to one's sense of good business judgment. It smacks of a sound scientific system. Accordingly, a group or board of experts set up requirements for types of arms that appear to be needed. Carefully formulated documents are prepared, usually in some detail.

"Requirements" are excellent in theory, but sometimes defeat their purpose in practice. For nowhere in the arms-development process does there exist a greater need for imagination, understanding, experience, judgment, and, finally, evaluation than in "requirements," but these factors are often neglected. *In setting up requirements the user and project engineer should be brought close together.*

The history of the development process shows us again and again that invention or engineering ingenuity have in many cases blazed the trail which requirements have followed.

Long Struggle

The machine gun itself as a type of weapon struggled for years to force recognition of the requirement for such a rapid-fire, area-sweeping arm. Even the repeating rifle struggled for years to replace the single-loader, as did the revolver versus the single-shot horse-pistol.

The Lewis light machine gun had a major influence in setting up post-1918 European requirements for 20-pound, magazine-fed, air-cooled, bipod-mounted automatics or LMG's. Our own country had very concise detailed requirements, with numerous printed copies, for a

semiautomatic rifle long before 1917. Here the requirement led the way—an exception.

However our requirements stated that the rifle should have the appearance, balance, and shape of the bolt-action M1903, hold five or possibly ten rounds, and mount the standard M1905 bayonet. As early as 1925, several designers offered models having 20-shot detachable box magazines.

Requirement Confirmed

But in 1925 the requirement for not more than ten shots was confirmed. Accordingly, the M1 rifle was committed to an 8-shot nondetachable magazine, etc. World War II experience vindicated the 20-shot box with its obviously superior firepower.

There is increasing recognition, long overdue, of the fact that requirements should be of a most generalized nature, decidedly broad and decidedly brief. Detailed specifications should be avoided. Boards and committees are essential, sound, and sensible. Two or more heads are better than one, but too many heads won't get ahead.

The arms-development process is greatly enriched by experience from the field. There is no lack of information as to arms performance and, to a lesser extent, arms requirements. Here again judgment and careful evaluation are mandatory. One can find combat-user testimony for and against almost any weapon he can name or imagine.

Classic Example

A classic example from World War II was the air-cooled versus the water-cooled machine gun. In the final analysis, the pro-water people expected to fight in well-watered areas, the pro-air adherents mostly in dry terrain (deserts, etc.). The unavoidable need for mobility, of course, watered down the water-cooled enthusiasm, though in several cases our troops combined the light MG tripod with the water-cooled gun in Pacific landings.

Not infrequently field reports and combat experiences become confused unless a common denominator is applied. For example, one may hear that the carbine is "no good." Investigation discloses that troops were firing this special-purpose, close-range, pistol-replacing weapon at 500-600 yards—more nearly the maximum effective range for semiautomatic rifles, BAR's, and light machine guns.

A new type of arm is issued to replace the older type. Some units report the new arm is superb; others say it "stinks." Usually the unfavorable units have had necessarily very brief training and instruction with it.

All these and similar user factors must be taken into account in the arms-development process.

On the technical or mechanical side, several warning signs must be posted. For example, a simple weapon which average people can reasonably and readily understand and operate is often a better investment than a complex push-button mechanism requiring extensive specialized training and master-of-science maintenance.

In the sporting-arms field, aesthetic appearance or beauty is one of the major necessities, but in the military only functional pulchritude has any place. Some military weapons have suffered seriously from the attempted imposition of bathing-beauty silhouettes.

"The history of the development process shows us again and again that invention or engineering ingenuity have in many cases blazed the trail which requirements have followed."

Arms development and ammunition development go very much hand in hand. This is a marriage of necessity, not always of convenience. The most significant advances in arms development have accompanied major developments in ammunition; for example, the metallic cartridge completely packaged, smokeless powder with high-velocity bullets and improved center-fire primers. *On the whole, the development process is evolutionary rather than revolutionary.*

Follow the Case

It is rare indeed to find any eminent obstetrician whose hands are not wet and bloody at the birth of a baby, or who does not personally follow the case for some months until all is well and the pediatrician takes over. There is some medical evidence to support the methods of the old-time family physician who personally knows, sees, and understands his individual patients. In the enthusiasm of pseudoscientific endeavor the need for such individualized expert attention is lost in the muddle of organization charts, systems, and paper planning.

But notwithstanding the endeavors of many well-meaning uninitiated theorists and eager-beaver executives, the arms-development process enforces this fundamental demand for personalized individual and skilled-group follow-up of the specific development. An instance very much in point is quoted from the U. S. Navy's, "The Machine Gun," by Col. George Chinn, regarding the Gardner machine gun of 1874-1879, made by Pratt & Whitney, caliber .45-70. In the morning of an 1875 Navy test 6,631 rounds, .45-70 (black powder), were fired in less than 19 minutes. There were 5 failures to extract.

Extractor Repaired

"At noon Messrs. Francis Pratt and Amos Whitney were allowed . . . to put the right-hand extractor in working order. The hook . . . was dulled and it was filed to provide more bite into the inside rim of the cartridge. The shank was bent . . . to increase spring tension."

Two thousand rounds were then fired in one burst at an average rate of 380 shots a minute. Francis Pratt then fired a 100-round burst in 11 seconds (545 per minute rate). No failure occurred in the afternoon firing of 5,000 rounds.

"The quick fix resorted to by company officials . . . proved to be the correct diagnosis and cure."

The above is but one of a great many examples of this most important aspect in the arms-development process.

In the Lewis gun chapter of "The Machine Gun," where reference is made to the Naval Aviation Ordnance Section of 1917, Colonel Chinn quotes a most significant Navy letter of organization:

"The principal function of this organization is *to harness authority and responsibility so that they can never be separated* . . . One man is to be responsible for each . . . development from its start to completion . . . its issue, its service performance . . . overhaul or repair. *Given this responsibility he is to be clothed with the requisite authority over all its details.*"

Shock Tests of Ordnance

Naval Ordnance Laboratory Develops New Techniques

John H. Armstrong

Chief of the Mechanical Evaluation Division, Technical Evaluation Department, Naval Ordnance Laboratory, White Oak, Md.

"CAN we beef up the firing mechanism enough so that it can hit the water that fast and still not go too far out of balance for use at high sensitivity?" is a question typical of those which more and more determine the feasibility of whole new classes of naval weapons.

Shock Sets Limits

Limits on the tactical use of aircraft-laid mines, antisubmarine rockets, homing torpedoes, and depth charges are frequently set by the ability of their critical components to withstand the mechanical shock involved in launching, water entry, and target impact.

Most conspicuous example, perhaps, of an inherently delicate device whose practicability is entirely dependent on extreme shock resistance is the gun-fired proximity fuze whose tubes, condensers, and resistors must withstand setback forces of ten to twenty thousand times that of gravity during their ride out of the barrel.

Naval influence mines with considerably more complex firing mechanisms must survive shock patterns containing compontents in excess of three thousand G's, and even the relatively moderate boost accelerations on large missiles are sufficient to necessitate gyros, computers, and control systems of shock-resistant design well beyond anything required in piloted aircraft practice where human limitations set a ceiling on the shock environment.

Testing Difficulties

Developing and proving shock-resistant or inertia-operated designs by full-scale testing in the field is generally a difficult, expensive, and, worst of all, lengthy process. Components cannot be evaluated until the entire weapon or even weapon system is available; the designer often must wait for suitable weather for his data; and since control and measurement of the shock actually experienced on a particular test is frequently impossible, use of statistical methods requiring large sample sizes may be the only avenue of attack.

As a result, the last 10-year period has seen the development by the Naval Ordnance Laboratory of a variety of simulation devices and techniques aimed at bringing into the laboratory critical service shock conditions.

Determining Shock

Since velocity and displacement produce no forces by themselves, components in a weapon are in effect in a "little black box" where the shock effects they feel are determined solely by the acceleration-time pattern at their location. The shock portion of environmental simulation therefore involves only the creation of controlled accelerations on a test vehicle in which the component is mounted as in the weapon. Either an acceleration or a deceleration can be used by properly orienting the specimen.

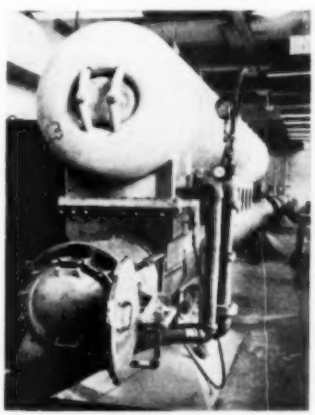

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Fig. 1. The 21-inch air gun for testing ordnance components weighs 38,000 pounds.

Two Patterns

Ordnance shock patterns can be divided loosely into two categories: high-energy and low-energy. A high-energy shock is one which lasts for a time relatively long in comparison with the natural period of vibration of the critical components which are subject to it. Examples are the setback forces on a projectile which endure throughout barrel travel and the drag forces which retard an aërial mine or torpedo after it has entered the water at high velocity.

In general, high-energy shock effects cannot be avoided by cushioning. After the travel of as thick a cushion as space will permit is exhausted, the acceleration is still acting, and the cushioned part will be brought to the same velocity as the body of the weapon in an often spectacularly destructive way as the cushion goes solid, with effects which may be many times worse than those on a solidly mounted item. In other words, the designer must simply learn "to live with" this type of shock.

High Energy Involved

High energy is involved in this problem because velocity is the time integral of acceleration, and the kinetic energy of a body is proportional to the square of its velocity. In decelerating from 800 feet per second air velocity to its sinking rate after water entry, a 25-pound mine component will give

up some 250,000 foot-pounds of energy, and the major requirement for simulating such effects adequately in the laboratory is a means for providing and controlling great instantaneous power.

Low-Energy Shocks

Low-energy shocks are perhaps more prosaic but by no means necessarily less destructive. In these shocks, whose durations are short relative to the natural period of the critical items, the exact value of acceleration reached is usually not particularly important; it may be very high and yet leave no permanent damage because the item is able to absorb by elastic deflection the small amount of energy involved.

The most significant parameter in describing the severity of short, sharp shocks is usually the impulsive velocity change involved. Cushioning may be effective against low-energy shock provided that trouble from vibration resonances can be avoided and that high-energy shocks are not also present.

Probably the most common source of low-energy shock is accidental dropping in handling a weapon or component. A projectile traveling at high speed passing through light plate and a depth charge subjected to the shock wave from the explosion of a near-by charge also receive short shock patterns.

In the simulation of low-energy shocks, gravity is usually an adequate source of power as in a conventional drop tester. The instantaneous forces are high, however, and the shock pattern decays rapidly in passing through a structure of any appreciable flexibility.

Establish Pattern

Before simulating a shock pattern, in the ideal case, the pattern involved in the corresponding field condition should be established. Accelerometry has made tremendous strides in the past few years with the advent of various piezoelectric, resistance strain gage, vacuum-tube, and other types of pickup, but it is still somewhat in the stage of the measurement of the output of research—figures are difficult to obtain and then there remains the problem of interpreting their real significance.

Though telemetering makes it physically possible to get acceleration from ordnance devices back to the laboratory, the competition for channels makes it likely that we will always have to rely to a major extent on indirect calculations, experience from comparable field and laboratory results on similar designs, and "educated guesses" in setting test conditions for laboratory simulation.

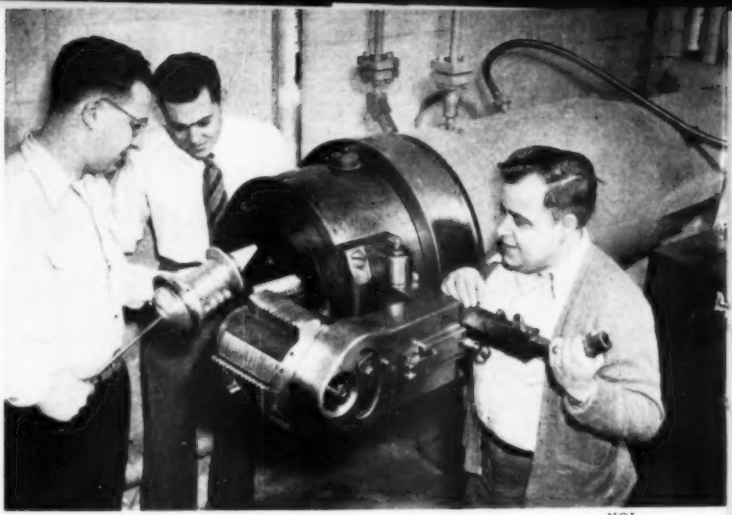

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Fig. 2. The piston shown above being inserted into the high-G air gun carries a projectile fuze that will be accelerated at 18,000 times the force of gravity.

Water-Entry Shock

An early critical shock problem at the Naval Ordnance Laboratory was water-entry shock damage to aircraft-laid influence-mine components. This was primarily a high-energy shock problem and was first attacked by subjecting components to accelerations in a centrifuge.

This provided an accurately controllable acceleration of indefinitely long duration, but major differences in the effect of a shock pattern on a structure result from changes in the rate at which a given peak acceleration is applied, and these dynamic effects were not simulated as the centrifuge slowly came up to speed.

In 1943, shock-testing air guns were developed and went into service. Guns of 15- and 21-inch bore are now in use. The release mechanism used in these guns restrains the piston prior to release by the impingement of a circle of steel balls on the lip of a hardened steel tube attached to the test specimen carriage or piston.

When a sleeve surrounding the ring of balls is withdrawn hydraulically, the balls are freed to fly outward, rapidly but controllably releasing the piston and initiating the acceleration which constitutes the test.

The maximum working pressure of 1,000 pounds per square inch produces an accelerating force of 345,000 pounds in the 21-inch gun (shown during assembly in Figure 1), and the peak resulting acceleration on a 150-pound piston is therefore 2,300 G.

Since the peak acceleration depends on the pressure, while the duration of the acceleration also depends on the volume of air used (which can be varied from 1.5 to 11 cubic feet), a considerable degree of independent control over the two factors is available.

Communication

To a considerable extent the value of laboratory shock-testing methods depends on the improved communication possibilities afforded. Multiple-channel contact strip and brush arrangements have therefore been devised and applied which permit electrical communication with the specimen throughout the test. This permits determining if a set of timing-clock contacts chatter during shock or if a missile computer unit becomes microphonic during boost.

Sufficiently noise-free contact is achieved to permit measuring instantaneous values of stress in critical parts by means of electric strain gages—thus making it possible to fulfill the request of one engineer to test his one and only test sample to "just before destruction."

Successful operation of the 1,000 p.s.i. guns led to a desire to extend their

power to include the acceleration range found in 3-inch and larger naval guns. Working pressure was raised to 15,000 p.s.i. in the high-G air gun (shown in Figure 2) which was constructed from an obsolete 5-inch bag-loaded gun.

Disk Release

A ball release mechanism capable of withstanding the 295,000-pound piston load would be far bigger in diameter than the gun, so its place is taken by a pregrooved brass or aluminum disk which shears at a calibrated pressure and initiates the shock. Accelerations of 3-inch gun fuzes of up to 50,000 G are attained.

Special expendable pistons with integral shear diaphragms have reached 120,000 G accelerations in studying 20-mm. fuze difficulties which could not be resolved in actual firings where recovery was impossible.

Simulation of low-energy shock patterns does not ordinarily involve such powerful machines as the air guns, but it brings its own problems. Drop testers up to forty feet high in which the test specimen rides a carriage through its collision with an anvil have become reasonably standard devices. The height of drop determines the striking velocity and therefore the impulsive velocity change.

Shock Controlled

Duration of the shock is controlled by the design of the striking faces and by insertion of some yielding material such as lead, sand, or a spring between carriage and anvil. A surprising range is needed; some tests for determining the firing sensitivity of point-detonating fuzes are made with drop heights as low as a thirty-second of an inch, while fuze-safety tests may consist of a 40-foot drop with nothing but air between the hardened faces of carriage and anvil.

The 40-foot steel-on-steel test is intended to represent the upper limit of possible accidental handling shock and results in accelerations, estimated to be in the range of 70,000 G, too high and too short in duration to be resolved completely by any existing accelerometer.

Rough-Handling Test

Rough-handling evaluations of complete weapons ordinarily involve no equipment more subtle than a solid steel-and-concrete slab and a hoist. They are none the less important in the over-all evaluation of the suitability of ordnance and its packaging, since the axiom that "nobody drops a grand piano very far" which applies to civilian use may not fit military transportation and service conditions.

Where the safety of explosive firing devices is concerned, however, and no possibilities of hazard must be overlooked, carefully regulated conditions are warranted, as in the fuze rough handler shown in Figure 3 which is now undergoing evaluation on fuzes of known characteristics to determine its effectiveness in detecting unsafe tendencies.

Military requirements are not considerate enough to package all shock patterns neatly in high- and low-energy categories. Rather they may be combined into complex patterns, as in some high-velocity water-impact situations, or result in single magnificent wallops such as hard-target accelerations where the velocity change may be several hundred feet per second and yet the pattern is sharply begun and ended as in low-energy shocks.

Combination Tests

This has led to the use of several combinations of drop-test and air-gun principles. To superimpose the very short "spike" of acceleration that results from high-velocity water-surface impact in certain weapon-case shapes upon the longer-duration water-drag deceleration, the specimen is mounted on a subsidiary carriage in the air-gun piston which is permitted to remain stationary as the piston accelerates for a fraction of an inch. A collision producing the desired spike then occurs and the carriage and piston continue on together under the accelerating force of the air to simulate the drag phase.

Many other important areas are far from thoroughly explored and conquered, though, and shock-simulation development is currently proceeding in the following general directions:

1. Refinement of techniques in accordance with better analysis of or data on service conditions.
2. Development of machines for simulating effects not possible with current types.
3. Development of simplified, relatively low cost versions of the research-type shock machines for use in ordnance production establishments and at contractors' plants for production inspection and quality control (a 16-inch-bore simplified air gun, for example).

Continued Development

Remaining problems are challenging, and in some cases the requirements seem impossible to fulfill. Considering the successful developments of recent years in simulation areas which at one time seemed equally unlikely of solution, however, developments are proceeding optimistically in those directions in which the potential savings make the gamble well warranted.

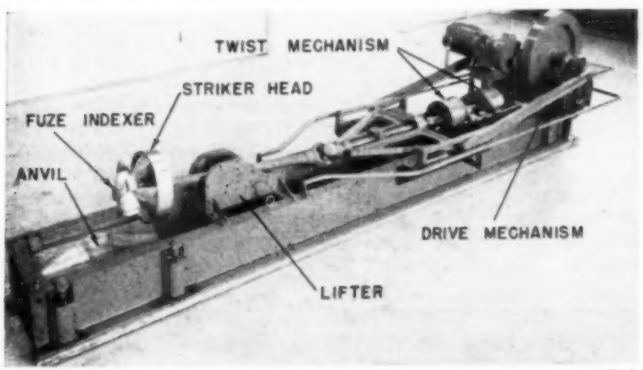

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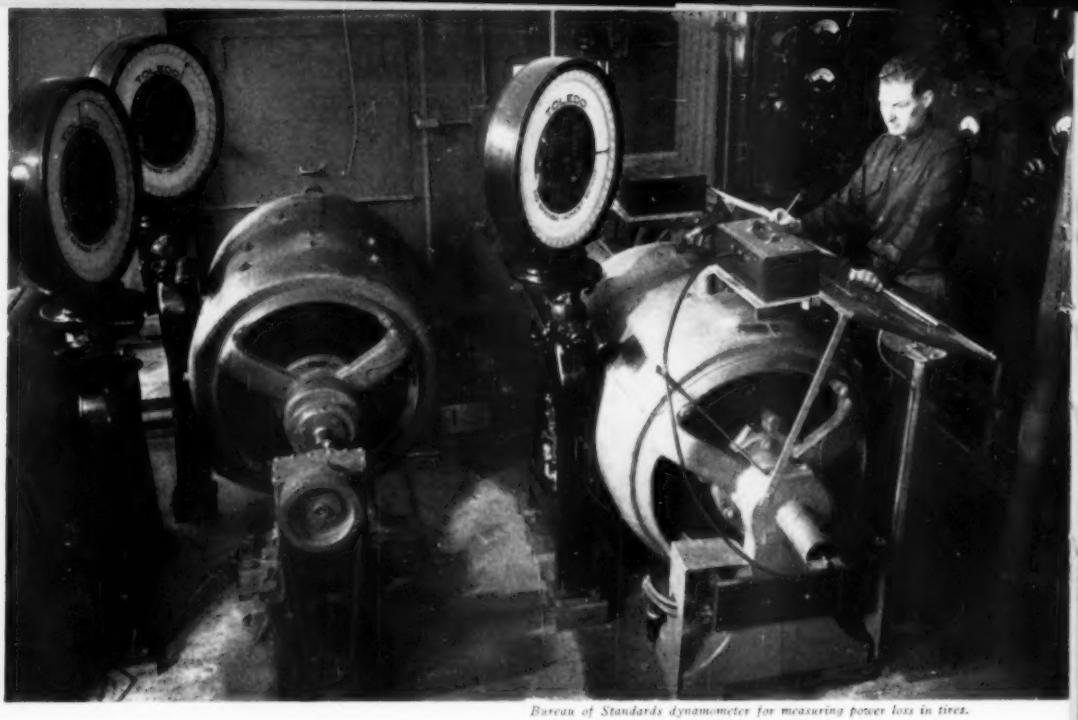
Fig. 3. This fuze rough handler subjects a fuze to 1,024 blows in 962 accurately indexed orientations with violent shaking and twisting motions added.



Bureau of Standards dynamometer for measuring power loss in tires.

"Proof Testing" Rubber Tires

Important Function of the National Bureau of Standards

R. D. Stiehler

THE twentieth century is frequently called the automotive age, but it is also the age of mobile, mechanized armies. The importance of the internal-combustion engine in these developments is well recognized. However, even without the internal-combustion engine, the self-propelled vehicle would probably have been developed.

Different Situation

On the other hand, the situation would be entirely different if a material with the properties of rubber were not available. The iron horse would still rule transportation on land while transportation in the air would probably have to depend upon hydroplanes instead of land-based aircraft. For without rubber, both the automobile and the land-based aircraft would be impractical.

Research has revealed the secret of making synthetic rubbers that approximate the natural product. But thus far a substitute for the rubbery properties of rubber has not been found.

Properties of Rubber

What then makes a material rubbery? If a scientific examination of rubber is made it is observed that rubber has the combined properties of a solid, a liquid, and a gas. It has the form and shape of a solid. When force is applied, it is deformed like a viscous liquid such as asphalt. The dimensions can be changed by several hundred per cent without rupture. However it has elastic recovery properties resembling those of a gas. On removal of the force of deformation, rubber rapidly and forcibly returns to its original shape.

Dr. Stiehler is chief of the Testing and Specifications Section at the National Bureau of Standards, Washington, D. C.

Rapid Recovery

The ability to undergo large deformations and recover rapidly makes a material rubbery and makes rubber irreplaceable as an elastic material in engineering. It is also the property required for the elastic member between vehicle and roadway when a vehicle travels on roadways that do not have the smoothness of steel rails.

Thus the development of the automobile became dependent upon the development of the rubber tire. The first tires were made of solid rubber. Since rubber is a viscous as well as an elastic

material, these tires became very hot in service and could not be used continuously at high speeds and under heavy loads. The discovery of the pneumatic tire overcame this deficiency to a large extent by substituting a more perfectly elastic material—air—for the bulk of the rubber.

However, since the air pressure would blow up an all-rubber tire like a balloon, it was necessary to reënforce the pneumatic tire with a flexible nonstretchable material to retain the shape of the tire.

Variations in Quality

With the growth of the tire industry, large variations in tire quality developed. To insure economy in Federal purchases and to permit all manufacturers to bid for Government business on the basis of performance, specifications and methods of test to insure conformance with specifications were needed. About 1920, investigations were begun at the National Bureau of Standards to develop objective procedures for evaluating tires.

Because a tire is composed of other materials in addition to rubber, the tests ordinarily used for vulcanized rubber compounds were of little use in predicting tire performance and serviceability. It was therefore necessary to work out new methods of test. These early studies led to the development of the endurance test for tires which is now widely used in the tire industry and in the current Federal specification for pneumatic tires. This test has played an important part in improving the quality of tires on the market.

Power Loss

These studies also showed that the variation in power loss among the different brands of tires produced during the 'twenties affected fuel consumption by about ten per cent. Power loss is that portion of effective power produced by the engine which is "absorbed" by the tires when it is converted into heat. Power loss thus not only decreases the efficiency of operation of a vehicle but can contribute to tire failures if the ensuing heat is excessive.

Production of synthetic rubber tires began during World War II, and the variation in power loss between different brands of tires became much greater than ever before. There was also a large increase in the number of tires purchased by the Government.

These facts indicated that the Government could save several million dollars a year if tires were selected on the basis of performance through a suitable specification and testing program. Therefore, at the request of the General Services Administration, the National Bureau of Standards intensified its program for the development of tire-testing methods.

Thus far the tire program has led to the development of the following tests which are currently in use at the Bureau for the evaluation of tires: (1) power loss and running temperature, (2) endurance or fatigue resistance, (3) energy of rupture (plunger test), (4) growth of tread cuts and cracks, and (5) tread life.

Tests Important

The first four of the tests are conducted in the laboratory; the last is a road-service test. These tests were chosen because of their importance in relation to the serviceability of the tire and because objective methods for making them have been developed. Other tests that will be used when suitable methods are worked out include skid resistance, accelerated aging, and noise.

Power loss in tires is disadvantageous for two reasons. First, the power lost in a tire is converted into heat, which increases the temperature of the tire, and the higher the power loss the greater is the running temperature. In large tires the temperature in service may become higher than the temperature at which the tire was vulcanized. As a consequence, the textile cords and the rubber deteriorate rapidly, and the tire fails.

Fuel Consumption

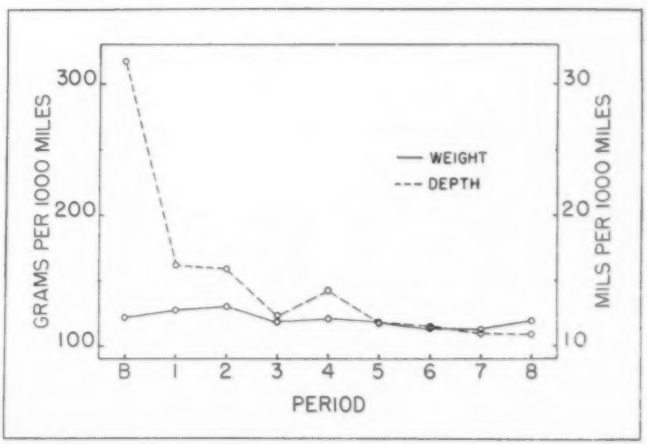
The second disadvantage of a high power loss is the consequent increase in fuel consumption and power requirements of the engine. As most passenger cars have a surplus of power, an increase in the power loss of a passenger tire is not serious except for the increase in fuel consumption.

However, in the case of trucks, particularly tractor-trailers with as many as eighteen tires, any increase in power loss of the tires may have a pronounced effect on both vehicle performance and fuel consumption. The effect is particularly noticeable on hills where the magnitude of the power loss in the tire may determine whether shifting of gears is required.

Power loss is influenced by both composition and design of the tire. The large increase in power loss that occurs when synthetic rubber is substituted for the natural product is the principal reason why truck and bus tires must be made almost wholly from natural rubber. The major effort today in synthetic-rubber research is to develop a more elastic material that will have lower power loss.

Power loss in a tire is determined at

Chart, below, shows average rate of tread wear during NBS road tests.



the Bureau by means of two dynamometers. One dynamometer measures the power required to drive the tire while the other measures the tractive effort, or power transmitted by the tire to a steel drum. The power loss is the difference between these two measurements after correction has been made for bearing friction and windage.

Tire Fatigue

The flexing of a tire in service, particularly at elevated temperatures, causes fatigue of the cords and rubber. Both composition and design affect the endurance of a tire, but not necessarily in the same way as they affect power loss.

Thus, while a tire with a low power loss may not have good fatigue resistance, it is generally true that a tire with a high power loss will have poor fatigue resistance because of the rapid deterioration at the high running temperature, which is near the boiling point of water. Tests on different brands of tires show a spread in running temperature of about thirty-five degrees Fahrenheit.

The test which measures endurance or fatigue is also a dynamic test and involves running the tire against a steel drum continuously for several days using regular motors instead of dynamometers as the motive force. The load on the tire is increased at stated intervals during this time.

The test is continued to failure for research studies but is discontinued after a specified time when testing for compliance with the Federal specification. Running temperatures may also be measured during the test.

Rupture Test

The energy required to rupture a tire is a measure of the strength of the tire and its bruise resistance. The rupture test is a static one in which the rupturing force and deflection are measured at the moment a cylindrical plunger with a rounded end breaks through the crown of the tire. From these measurements the energy of rupture is determined.

The test is usually made on an unused tire. If it is made on a tire in service or on one that has undergone the endurance test, the energy for rupture may be much lower. The difference between the rupture energies before and after use can thus serve as a measure of the deterioration that has taken place.

In this way it has been found that tires made with cotton cords deteriorate much faster than those made with rayon or other synthetic fibers. The development of the plunger test into an accelerated aging test is now in progress.

When a tire is poorly designed or when inferior tread compound is used, cuts or cracks in the tread grooves may increase rapidly during service and cause premature failure of the tire. This condition is determined in a test which is conducted along with the endurance test. Predetermined numbers of cuts are placed in the tread grooves before the endurance test, and the lengths of the cuts are measured after the test to determine cut growth.

"With the assistance of Army Ordnance, the Bureau is developing a testing machine designed to evaluate endurance, running temperature, cut growth, and tread wear of tires in a single test. The machine will test as many as sixteen tires simultaneously."

Tread Life Checked

The present test for tread life is based on investigations made during World War II. When our supply of natural rubber was cut off, both civilian and military transportation were seriously threatened. Many substitute materials were suggested for recapping tires. Some of them were obviously of no value. The more promising materials were submitted to the National Bureau of Standards for evaluation.

Since there was no standard test for determination of tread life, a search was made for a rapid and reliable method for measuring the rate of wear of tire treads. The tire industry had been measuring the rate of wear by the decrease in depth of the grooves in the tread.

However, the decrease in groove depth does not take place at a constant rate but becomes slower with an increase in mileage because of the change in the area of tread in contact with the roadway. Thus, to obtain reliable results, it was necessary to wear the tires smooth in long and expensive road tests.

Weight Loss Constant

At NBS it was found that the rate of loss in weight of a tire is essentially constant throughout the life of the tread. This finding made possible much shorter and less expensive road tests since the rate of tread wear could be determined by differential weighings in a small fraction of the miles required by the depth method.

The shorter road test that was developed as a result of this work forms the basis for the present tread-life test in the interim Federal specification now in effect.

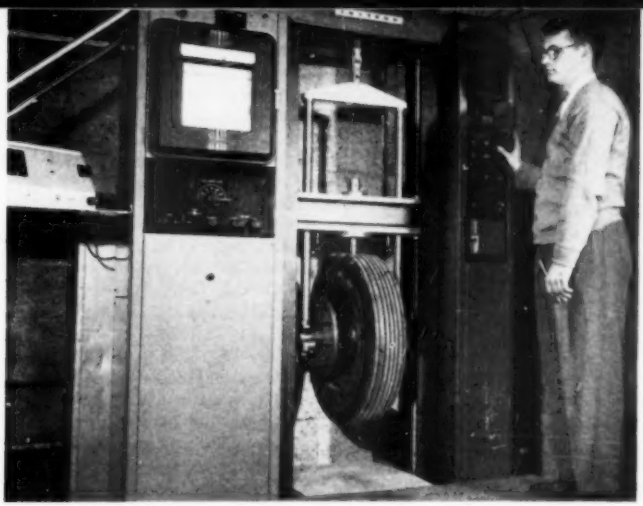
The large number of variables on the road makes the road test much more difficult to control than a laboratory test. Recently the Bureau has developed an improved method of road testing for tread wear which utilizes the weight-loss method but also employs a statistical design, based on the Latin square, to compensate the differences in the treatment received by each tire.

In this way, differences in wear due to the use of the tires on different vehicles or in different wheel positions are taken into account. Because of changing climatic and road conditions, the tires are always evaluated relative to those included in the same road test. Although a more absolute method might be desirable, the NBS method does provide significant and useful information.

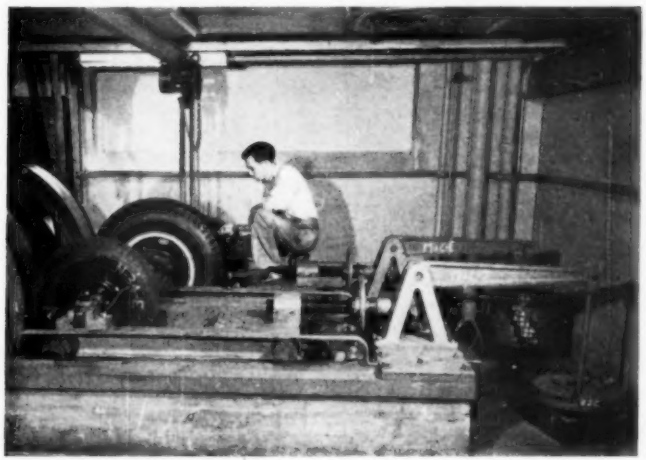
Four Trucks Used

The Bureau is now conducting road tests with a fleet of four trucks equipped with 4-wheel drive and three trucks having 6-wheel drive. The vehicles with 4-wheel drive are used in testing passenger and light truck tires having 15- and 16-inch rims while the other trucks are for testing truck tires having 20-inch rims. The tires are run about 500 miles between measurements and are rotated from one wheel position to another after each 500-mile period in accordance with a 4x4 or 3x3 Latin square design.

After each tire is tested in each wheel position, the remaining tread is removed by buffing to determine the total weight of the tread. Tread life is



Tire is tested, above, for strength and bruise resistance. Below, technician makes cuts in tread grooves of a tire before starting endurance testing.



After testing in each wheel position, the remaining tread of the tire is removed by buffing, below, so that total weight of tread can be determined.

then calculated from the tread weight together with the rate of wear determined in the road test.

A New Machine

With the assistance of Army Ordnance, the Bureau is developing a testing machine designed to evaluate endurance, running temperature, cut growth, and tread wear of tires in a single test. The machine will test as many as sixteen tires simultaneously.

In addition to the investigations dealing specifically with tires, the Bureau is conducting other studies of a more fundamental nature that directly concern the use of rubber in transportation. One such program is of concern to Army Ordnance. Tires and other rubber products that are to be used in the arctic regions must meet special requirements.

At very low temperatures, rubber becomes hard and brittle like glass and fractures easily. The temperature at which this change occurs varies for different rubbers and is called the "glass transition temperature."

Pioneering investigations in this field were made at NBS before World War II. These studies are being continued, and recently an interferometer was developed that automatically records the transition temperature.

Of the rubbers commercially available today, the silicone rubbers have been found to have the lowest glass transition temperature. However their other properties unfortunately restrict their use to special applications.

Dynamic Properties

An investigation of the dynamic properties of rubber is also under way. As has been mentioned, the viscous properties of rubber result in wasted energy in tires. The losses, however, are dependent on the frequency of vibration.

In this study, the viscous and elastic properties of rubber are being determined as a function of frequency so that rubber may be used more intelligently in tires and other products.

From studies such as these should come better rubber products for commercial and military transportation and improved methods of evaluation. The results should also lead to economy in Federal purchases and—what is particularly important to the Department of Defense—predictable operational performance.

Alaskan Bivouac

Members of the U.S. Army Learn How To Survive at Fifty Below Zero

Col. R. R. Van Stockum

THE faculty representative who met us at the plane in Big Delta was somewhat apologetic for unseasonal temperatures prevailing at the site of the Army Arctic Indoctrination School. On our take-off from Great Falls, Mont., the thermometer was hovering around zero; here in the "Icebox of Alaska," nearly 2,000 miles to the northwest, a slight thaw was actually in progress.

Big Delta

Big Delta is an Army post located in the Tanana Valley near the junction of the Richardson and Alaska Highways, 105 miles southeast of Fairbanks.

Contrary to popular belief, it is this portion of subarctic Alaska, well south of the tree line, and not the barren Arctic Slope that provides the extremely cold winter temperatures suitable for the test of men, supplies, and equipment in the rigors of winter warfare.

Big Delta was to be our base of operations for the month of January, and the surrounding heavily forested hills, muskeg flats, and frozen waterways were to provide the requisite environment. We were to find out the error of our initial impression of Alaska in January. For over a week, the mercury was to hang close to the 50-below mark. Falling mercury was accompanied by rising spirits on the part of the instructors—if not of the students.

We quickly discovered some of the manifestations of this extreme cold when experienced in the base-camp area. At 40 below the thermostat of a BOQ may be set at 85 degrees, but frost will form on the walls near the floor. Points of nails protruding from the outside will be covered with frost.

At 50 below, most metals crystallize readily. An officer shifting gears with appropriate enthusiasm one bitterly cold morning was surprised to have the lever snap off in his hand. And usually at 50 below there is a haze of ice fog, resulting from condensation.

More Than Survival

The mission of the winter course at Big Delta entails more than mere survival. It is to accustom the individual to the special problems of living and moving in such climes and the accompanying effects on tactics.

Colonel Stockum is attached to the staff of the commander of Amphibious Group 2, U.S.S. MOUNT OLYMPUS.

Survival is taught not on the pattern of an improvising Robinson Crusoe but from the standpoint of a properly indoctrinated military man, suitably equipped. However, in order to provide a proper understanding of the basic problem and thereby overcome the fear that accompanies ignorance, the school's schedule provides each student the opportunity to participate in building a lean-to and, better yet, the dubious pleasure of spending one night in it!

Fifty Below

Consequently, in the middle of January, halfway through our course, with the temperature approaching the middle fifties *below*, we students assembled somewhat reluctantly for the movement to Quartz Lake, the site of our lean-to bivouac.

Each of us was dressed appropriately for ski-joring under these conditions: first layer, "longhandled" underwear and flannel shirt; second layer, insulated intermediate trousers and jacket; third layer, outer trousers and parka.

On the feet we wore white felt "bunny" boots with woolen ski socks and felt insoles. Mukluks—soft, porous, and shapeless—the warmest type of footwear, were packed in rucksacks as they do not provide satisfactory ankle support for skiing. The hands were protected by three layers of mittens.

Special Clothing

Our ensemble, weighing less than twenty pounds, provided several features to control heat loss, to facilitate moisture loss, and to protect the body. It was loose so as not to restrict circulation. It was provided in layers to trap still air for insulation and to permit adjustment of attire in harmony with activity and air temperature.

My squad was assigned one M29C (Weasel) as a towing vehicle. We mounted our military skis and grabbed loops in a line which extended back from either side of the vehicle. Behind us another Weasel pulled, in addition to a squad, a one-ton sled carrying equipment for both squads. This included a rucksack packed with an arctic sleeping bag for each man, one day's rations, pioneer tools, mountain (Coleman) stoves, and cook pots.

As we commenced our 6-mile trip, we heard the distant roar of artillery fire, a reminder that the mercury had fallen low enough to provide optimum conditions for cold weather test firing.

Our first concern was frostbite, which can be simply described as freezing of the tissues. The face is particularly vulnerable, for it cannot be safely covered by a face mask which accumulates body vapor as ice and may hide frostbitten tissue.

Frostbite

Frostbite is a mere nuisance if noticed in time and warmed by the mittened hand; if allowed to develop through neglect or necessity, it can become serious.

Windchill, similar in effect, is caused by the combined cooling effect of air temperature and wind on a warm body. From experience, I can state that the face will show tell-tale whiteness more quickly at 25 below in a 25-mile wind than at a still 50 below zero.

Fortunately, extremely cold temperatures are usually unaccompanied by wind. But when ski-joring, obviously a relative wind equal to the velocity of the vehicle is induced during a dead calm. Thus there was reason for concern in anticipation of traveling at speeds up to ten miles an hour behind a Weasel.

In order to protect the face we closed our parka hoods, leaving only a small slit for vision through interlocking fur, although our view was more restricted than that of a horse wearing blinders.

No Casualties

Amazingly enough, our trip to Quartz Lake resulted in no casualties. In retrospect, I wonder how we escaped fractures, for we were not adept with skis by any stretch of the imagination. At noon we arrived, bruised but intact.

Bivouac Site

The site of our lean-to bivouac fulfilled the prescribed requirements. It was a forested area containing the necessary raw materials for our shelter and fires. It was covered with deep snow for insulation from the cold radiating from the ground. It was near an ice-covered lake which could be used as a water supply.

We quickly dismounted skis, unpacked our sled, chose the exact site for our lean-to, and carried our equipment there. Then, under the direction of the squad leader, the members of the squad immediately placed into effect the standard operating procedure for constructing the bivouac.

Two firemen equipped with an axe and saw built a small fire and prepared a hot drink for the rest of the squad. One continued to gather wood for this fire and for the lean-to warming fire while the other prepared the meal. Three bough-gatherers, equipped with axes and machetes, procured boughs for the roof and floor of the lean-to and prepared the squad latrine. Before the shelter was completed most of the other members of the squad found themselves gathering boughs also, so great were the requirements.

Building the Lean-to

The squad leader and three builders, working in pairs, leveled the site for the lean-to, built the framework, and placed the boughs. Then they erected the ski and weapon racks.

Our squad prepared a double lean-to. We worked continuously from noon until well after sundown (about 2:30 p.m.), jealously hoarding the limited daylight available. We were advised and assisted by the sergeant instructor assigned to the squad, an outstanding young man of great physical ability and military character.

Shortly after dark we consumed the heavy meal that had been prepared by the cook. While working at a feverish pace we had not felt cold. To avoid perspiring, most of us had stripped down to flannel shirts. Now that we had stopped to eat, even though we had replaced our outer clothing, the ad-

Above are shown the four layers of arctic clothing, left to right: long underwear, flannel shirt and intermediate trousers, intermediate jacket and hood, parka and arctic trousers. Below, preparing rations on the trail.

vancing chill forced us to hug the fire.

For this meal, we consumed 5-in-1 rations (furnished in large cans for group serving). With the air so cold as to cause grease to solidify on a spoon between mouth and container, we found this ration cooled too quickly when dished out to individuals.

Preferred "C" Ration

We would have preferred an individually packed ration, such as a "C" ration, which could have been heated and eaten in the same can. Care had to be taken to avoid frost burn resulting from touching cook pot or canteen cup with bare hands.

After dinner we allowed our cook fire to die out, relying for warmth on the lean-to log fire. Night shrouded our bivouac, but moonlight, filtering through the trees and reflecting from the snow, provided fair visibility. The mercury remained about the same—in the mid-fifties—but as we contemplated our sleeping bags, resting not on air mattresses but on pine boughs, the cold seemed to creep silently into our bodies.

Perspiration, the result of the day's activities, had clung to our socks to cool our feet. We crowded the fire, wiggled our toes, even scorched our boots without noticeably warming the feet. Fortunately we were not confronted with a tactical situation that precluded the building of fires and the removal and drying of footgear.

Early in the evening the commandant of the school made a tour of the bivouac area. He looked a little cold himself and even had his parka hood over his head—quite a concession to the weather on the part of this rugged veteran of the 10th Mountain Division.

"Coldest Bivouac"

With a smile of pride in his students, he confided to us: "Coldest bivouac in the school's history! Probably coldest bivouac ever made by representatives of the U.S. Army!" Then he added, "We have a heated Weasel available to take frost-bitten students back to camp. Don't expect any of you field officers to fall out, though." He stopped a moment to warm his hands over our fire, and then, with a parting injunction to "change your socks," was off with a cheery greeting for the next squad.

Having brought along, with considerable difficulty, my camera and flash attachment, I decided to preserve our bivouac for posterity. Stirring the members from their lethargy about the fire, I carefully posed them in a group. Then, exposing my fingers for a few seconds at a time, I connected the flash attachment and checked the aperture and shutter settings, now frozen in place as previously set at the base camp. "Smile! Look happy!"

I released the shutter. It clicked! But unfortunately it had functioned in a "visual vacuum," for the battery at 50 below had produced insufficient current to activate the flash bulb. Batteries, I now realized, unless kept insulated from the cold, operate at a fraction of rated efficiency in extremely low temperatures.

The more tired (or more hardy) of our group turned in early. In accordance with the doctrine of the school they removed their shoes and outer trousers, slipped into their sleeping bags, and proceeded with a rigamarole we called "the Arctic strip tease." Layer by layer, while inside the sleeping bags, they stripped down to their "long handles." This procedure was necessary so that they could lose a minimum of body heat while turning in, and still not perspire excessively while sleeping.

I took the fire watch for the first part of the night—and a close watch of the fire it was! I left my post, which was more *in* than *at* the fire, only to get logs to keep the flames high.

"Peeling" Process

About midnight, upon being relieved, I proceeded with the "peeling" process already described. I pulled the hood of my sleeping bag over my head and covered my face with the detachable fur-lined hood of my intermediate jacket. By breathing through the fur, I was able to obtain air without freezing my face.

Each of the five hours I slept was colder than the one preceding. The cold of the ground penetrated the snow, the boughs, the outer garments between boughs and bag, and into the sleeping bag itself. The heat and smoke from the fire ascended straight up to the treetops without diffusing into the shelter. There was no wind to favor either side of the shelter with heat.

Upon arising early the next morning, we quickly found agreement in our experiences and opinions: we had not slept warm; we were still cold; we were tired; we were hungry; we wanted to return to the base camp forthwith. The latrine had been an unnecessary facility during the night. In the words of the school's medical officer, "No one had gone outside to eliminate himself."

Unfortunately, our squad's duty cook had not been stirred in time to fetch water from the lake (with the assistance of an ice auger) or to melt snow, and so there was no time for the long process of preparing a hot breakfast.

Cold, tired, and hungry, we broke camp before the rise of the tardy winter sun and assembled for the 6-mile ski march back to base camp. Making a morning march without breakfast was a blunder we never committed again.

4,400 Calories Daily

A person living out of doors in such temperatures requires about 4,400 calories daily in order to meet the elementary requirements of the system and to replace lost body heat. A clerk in an office hut, or a soldier active outside only part of the day, may grow fat on such a diet—and certainly the subarctic in winter is no place for a fat man.

But on our trip back to camp we were definitely within the 4,400-calorie category. Empty stomachs were most demanding, expressing not just healthy appetites but basic and urgent requirements.

The casualties of this day in the field were only three or four cases of frostbite, temporarily incapacitating but not lasting in effect. One officer of field grade—a Marine, by the way—true to the colonel's injunction, skied back despite having frost-bitten toes. Most casualties affected the feet and were caused by tight shoes or excessive thicknesses of socks which restricted circulation and prohibited movement of the toes.

Learned Much

In twenty-four hours we had learned a great deal about the cold and the limitations that it could impose on troops operating tactically in the field. We were convinced of the efficacy of military equipment, particularly shelter, as compared with the field expedient. And we were glad indeed that base camp and hot breakfast were not far away!

Production stamina, tool-room accuracy ..lathe gets both with TIMKEN® bearings

THIS "Economy" lathe is designed to fill a specific demand for a medium-priced lathe which has these two qualities: ruggedness for general production work and accuracy for tool-room service. To insure these two qualities, Rockford Machine Tool Co. mounts the spindle and gear shafts on Timken® tapered roller bearings.

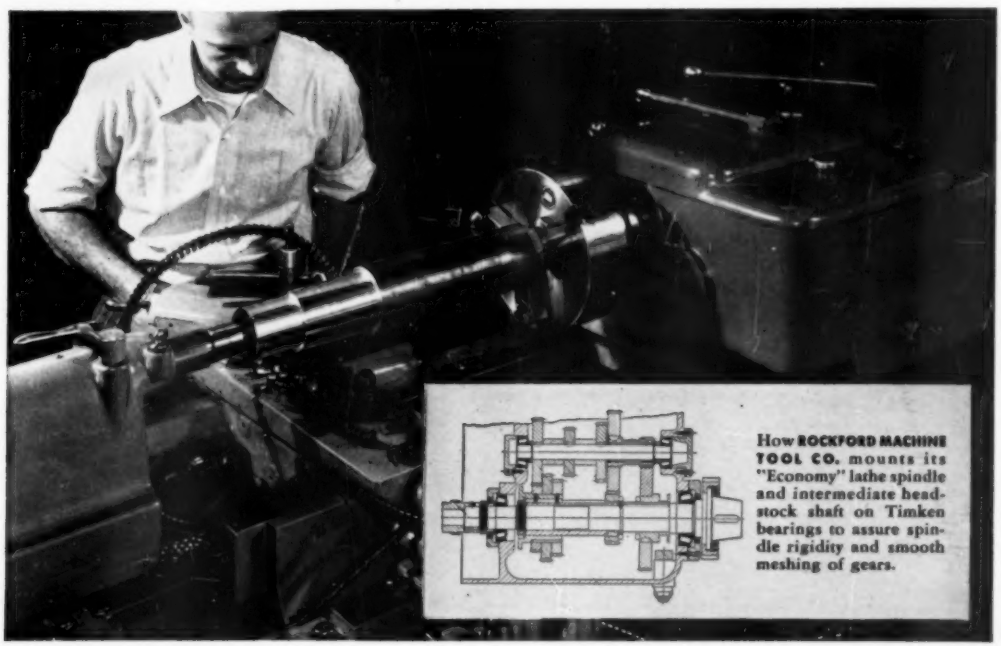
With Timken bearings, the spindle is held in rigid alignment. Precision is maintained. Gears mesh smoothly — with minimum wear even under the heaviest loads.

Because of their tapered construction, Timken bearings take radial and thrust loads in any combination. Line contact between rollers and races provides extra load-carrying capacity. The true rolling motion and incredibly smooth surface finish of Timken bearings practically eliminate friction.

Timken bearings hold shaft and housing concentric, making closures more effective. Because they are (1) precision manufactured, (2) engineered for the job, (3) made of Timken fine alloy steel, Timken bearings normally last the life of the machine.

When you buy or build machine tools, be sure they are equipped with Timken bearings. No other bearing can give you all the advantages of the Timken bearing. Look for the trade-mark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How ROCKFORD MACHINE TOOL CO. mounts its "Economy" lathe spindle and intermediate headstock shaft on Timken bearings to assure spindle rigidity and smooth meshing of gears.

FINISHED TO CLOSER TOLERANCES

Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods of the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

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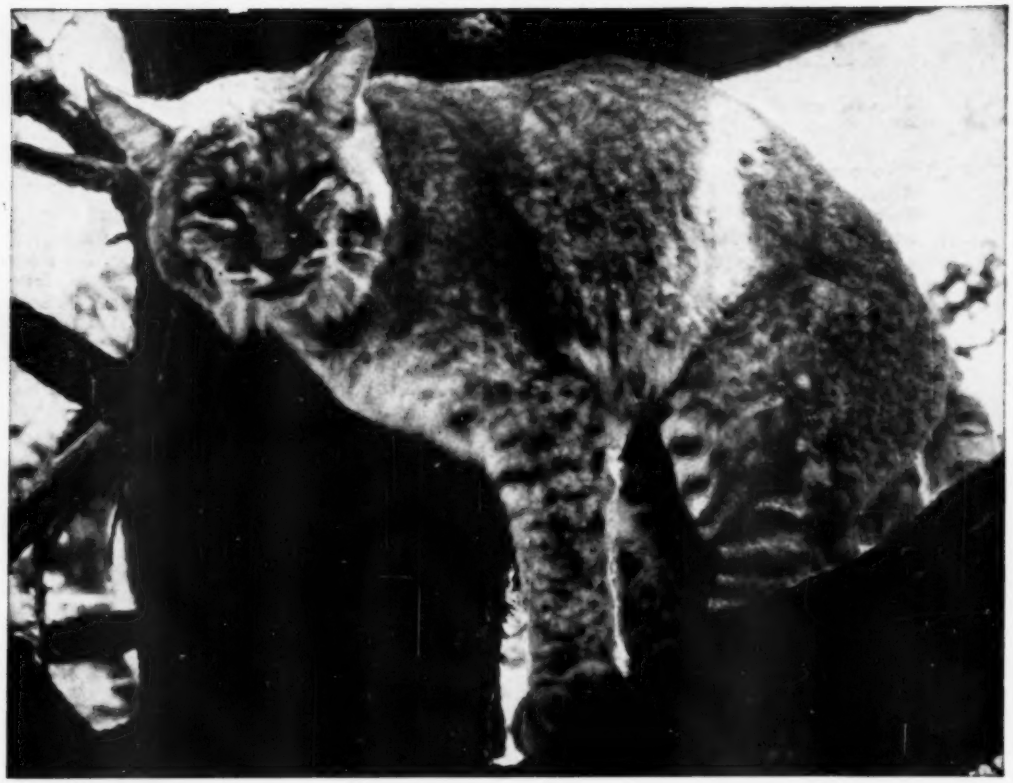
NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION ✳



Make it rough for Lynx Rufus

Felis lynx rufus—one of the common varieties of lynx, bobcat, wildcat or whatever he is called in your locality—is a bad actor. Beautiful, yes—but a predator that accounts for many a quail and rabbit and even pulls down deer when the snow is high.

When the lynx is on the rampage, you'll get a bang out of tracking him down and putting an end to his marauding. Remember, though, that conservation authorities recommend the control, not the extermination, of the lynx. He acts as a check against an overabundance of rodents and other small pests. See your local game regulations, too, before shooting the lynx.

Aside from controlling predators like the lynx, good sportsmen can also help conserve America's game by participating in local and national conservation programs.

N.R.A. RANGER

Write for free booklet on how to start a rifle club . . . win Ranger Shooting Emblems. Sportsmen's Service Bureau, Department D-3, Sporting Arms and Ammunition Institute, 343 Lexington Ave., New York 16, New York.

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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

DU PONT SPORTING POWDERS

WORLD-FAMOUS SINCE 1802

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